Industry and Power

June 1955

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Look for a belt with straight sidewalls and accurate positioned strength members that prevent sag in the "power line".

The "power line" or pulling section is the heart of a V-belt. It is here the belt strength members are located and it sets the load-carrying capacity of the drive.

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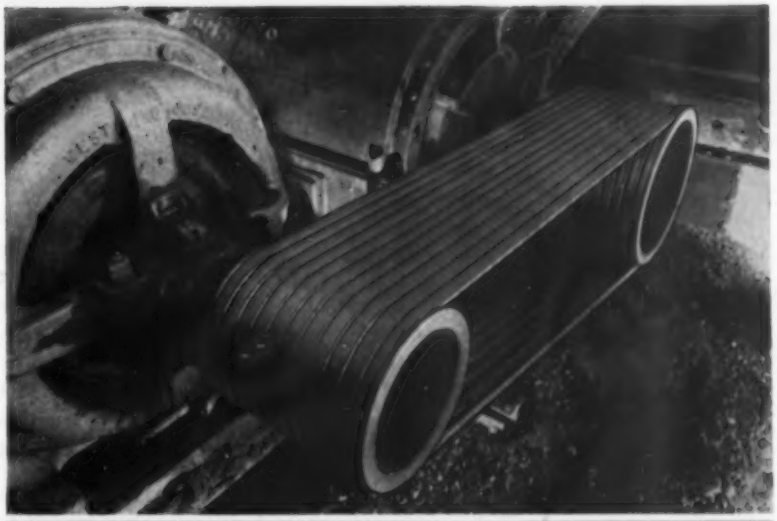
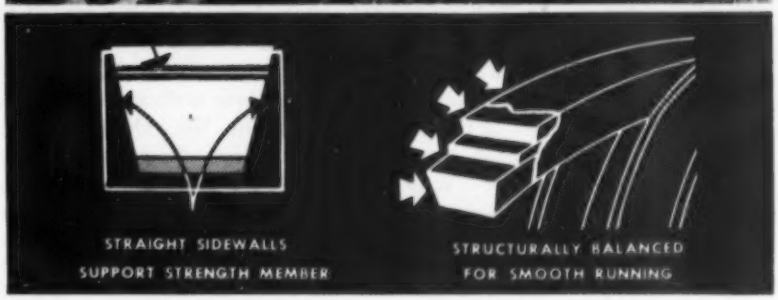
Specify, by name, the V-belt most carefully manufactured so that every part is balanced to deliver full horsepower capacity and "More Use per Dollar" . . . specify, R/M Super-Power or standard Condor V-Belts.





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For longer life under shock loads, R/M Super-Power V-Belts have a new synthetic super strength member which delivers up to 40% more horsepower capacity; fewer belts can be used on the same drive for the same horsepower. They are oil-proof, non-spark and heat resistant. Both R/M Super-Power and standard Condor V-Belts have straight sidewalls with strength members micro-positioned and destretched during manufacture. This prevents power waste and frequent shutdown for belt take-up. Let an R/M representative show you why R/M Super-Power or Condor V-Belts last longer . . . give you "More Use per Dollar".

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this month's comment

. . . from industry & power

our covenant with you . . . .

Last month we discussed I&P's *Credo* in this column. What purpose does that *Credo* serve? It serves as a new combination of words to give fresh meaning to the traditional field and purpose of I&P as we have already come to know it. *The Credo* is merely a new wrapper for the traditional package—a wrapper created simply because a fresh restatement of I&P's tradition looked to be in order when I&P came under the control of younger men. So *The Credo* amounts to the editorial objectives of we who seek to carry I&P forward—remembering our long-standing affiliations with, and affections for, its traditions.

Part of the new wrapping comes in the editorial approach. We are aiming for *vital* editorial material. We are all human beings—who happen to be concerned with Industry's Power Services. But, basically we are all human—buying cigarettes, shirts, cars, soap. We have children. We are interested in their welfare. We have been following the news of the Salk Polio Vaccine. Why should we not combine our professional interests in Industry's Power Services with our human interests? Why not tell the *vital* story of how men in our very business, Industry's Power Services, created the environment necessary for production of this vaccine? I&P went after that story.

So, you will find the story of the power services behind the Salk Polio Vaccine featured on the cover and running as the lead story in this issue. And the two reasons why we went for this story? First, it's a darn good power services story, full of the technical know-how that I&P likes to pack into each of its pages. (It demonstrates, too, that power services mean more than just firing a boiler.) Second, it has the vital appeal that any of us would respond to as humans.

This, then, is some of the manner in which I&P will carry forward in its traditional fields. We will get the vital stories behind the best of Industry's Power Services.

We are not stopping here. Next month, for example, I&P will improve its readability. We have called upon the best know-how in the editorial business to put even more sparkle into our pages. And it won't be too long before the I&P cover takes on a fresh appearance.

So there you have some of the elements in our policy for applying the best of fresh talent to the growth of our editorial covenant with you —a covenant that is constituted of 35 years of mutual loyalty. We have drawn up *The Credo* to reiterate our basic, traditional coverage. We are embarking on an editorial development program to bring you the vital power services stories of the day. We will be continually scanning our pages and covers to keep readability tops—so that you can pack maximum absorption into your reading time.

Finally, our incoming mail basket always will be ready for your comments. Let us hear from you.

Harold A. Bergen, Editor

The John Paul Taylor Publishing Co.
Commercial Bank Building, St. Joseph, Michigan

Industry and Power

Volume 68 **June 1955** Number 6

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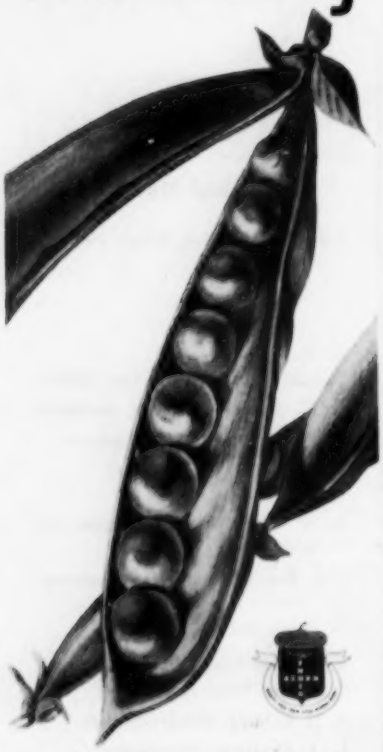
Uniformity



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nuclear news

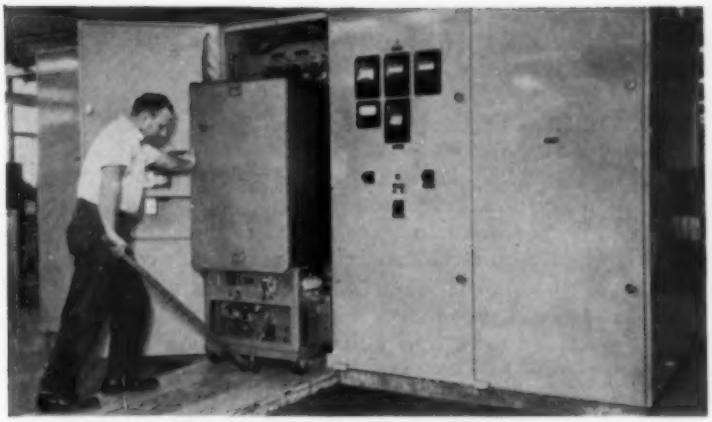
. . . about industry & power

Power reactors around the corner

Foster Wheeler Corporation and Pioneer Service & Engineering Co. have reported to the AEC that "nuclear reactor technology has progressed to a stage where it is technically feasible to construct and operate a nuclear reactor for central-station power generation with only a limited amount of pilot plant and component testing . . . None of the reactor designs included in this survey can produce economic central-station power. It is possible that engineering advancements resulting in long term irradiation, lower capital costs, reduced reprocessing costs, etc., may be achieved so that the selling price of power from a nuclear plant could compete with that produced from conventional fuels. However, the extent to which this is possible is not clear . . . . Considerable engineering and development work is required on any of the four promising reactor types before economical power can be produced." The picture is undoubtedly brighter today, simply because this report does not take account of the most recent advances in reactor technology. This report is dated October, 1953.

Positive steps toward nuclear power

"The basic requirements of a nuclear reactor for producing power are the same as those for a power plant using conventional fuel." This is the statement of Sherwood L. Fawcett, specialist in nuclear engineering at Battelle Institute. The designer of a nuclear power reactor faces a number of special problems. Among these, Fawcett said, are relative lack of previous experience; small-scale working models cannot be built because a certain amount of "size" is necessary before fission reactions are possible; special behavior of construction materials under radiation; and special protection for power plant workers . . . . More and more utilities are climbing on the nuclear power band wagon. Detroit Edison has earmarked $5,000,000 for developing a breeder reactor in collaboration with other firms associated with it in a special combine . . . . Commonwealth Edison is putting up $30,000,000 toward the price of a $45,000,000 nuclear power plant that it will own and operate near Chicago. The plant will have a net electrical capacity of 180,000 kw. Other firms in association with Commonwealth Edison will supply $15,000,000 in return for technical information, experience, and training which can

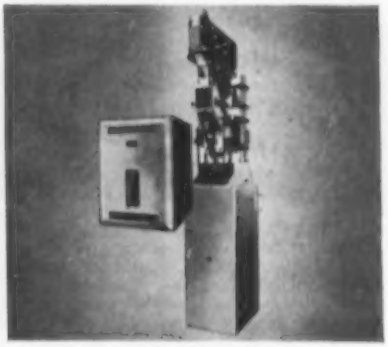


Metal-clad switchgear. Horizontal drawout air circuit breakers in rigid, all-welded enclosures. Available in ratings from 2400 v through 15 kv—50 through 500 mva interrupting and 2000 amp continuous.

Nonsegregated phase, metal-enclosed bus. For switchgear connections. In ratings 600 v through 6000 amp; 5, 7.5 or 15 kv through 5000 amp.

Unit substations. I-T-E primary and secondary unit substations can be supplied for any application—indoor and outdoor—and in any standard rating.

Low voltage switchgear. Ratings through 600 v a-c, 250 v d-c, 6000 amp continuous, 15,000 through 150,000 amp interrupting.



Individual breakers. I-T-E large air circuit breakers are available in a wide range of types and ratings, 600 v a-c, 250 v d-c, 750 v d-c.

NEW CONSTRUCTION ECONOMY TIP: BUY AN I-T-E "POWER PACKAGE"

Coordinated engineering, delivery and installation means a better investment

An I-T-E "power package" includes the complete power handling facilities you need for a new construction project, building addition, or simple expansion of electrical service—one unit or a complete system for application from generation to end use. You save many ways:

Sound planning. Talk with your local I-T-E application engineer about your general power requirements before you build. He'll work with you to determine the equipment needed to assure complete protection with greatest economy in total investment, operating costs, and construction time.

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Coordinated delivery. Shipments are made from I-T-E according to a predetermined schedule. Each part of the complete "power package" is delivered to the job when needed. This saves delays and eliminates inconveniences.

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For details, contact the I-T-E sales office nearest you—look in your classified directory under "Electric Equipment." I-T-E Circuit Breaker Company, 19th & Hamilton Sts., Philadelphia 30, Pa.

I-T-E CIRCUIT BREAKER COMPANY
Switchgear Division

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Jerguson Boiler Water Gages give Maximum Visibility, with no blind spots, within the boiler centers available. Special OS&Y valves with horizontal loop keep strain off gage under expansion and contraction conditions; compact design takes less space. Unique gage design with one-piece chamber and staggered glasses and covers eliminates blind spots. You get more gage in the space; more visible glass in the gage.

Gage can be turned at any angle, yet it has no stuffing boxes between gage and valves. Ten standard assemblies, WSP of 650, 900 and 1500 lbs. Visible glass to 18".

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Jerguson Truscale Gage with the New Convex Scale gives full 180° visibility . . . brings your liquid level reading down to your operating floor. Can read level from anywhere in the room. Sensitive to ½ of 1% of scale reading. Meets boiler code for 900 psi or higher. Available with lights, horns and repeaters.

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be obtained only from day-to-day participation in designing, building, and operating a full-scale nuclear plant.

Atomic energy is big business

Private industry will spend approximately $300,000,000 of their own money in the next four years on atomic energy according to a report released by the Atomic Industrial Forum. The report reveals that between three and five million kilowatts of electric capacity may have to be built and operated on an uneconomic or break-even basis before reactor-generated electric power can become competitive with conventional power. Large reactor power plants will become economic some time after 1962. By 1963, the report continues, manufacture of components for reactor plants may be over a $700,000,000 a year business. By 1965, atomic energy developments, both government and private, will call for a total of 30,000 to 40,000 scientists and engineers -- about double the number in both categories today.

Another appraisal is offered

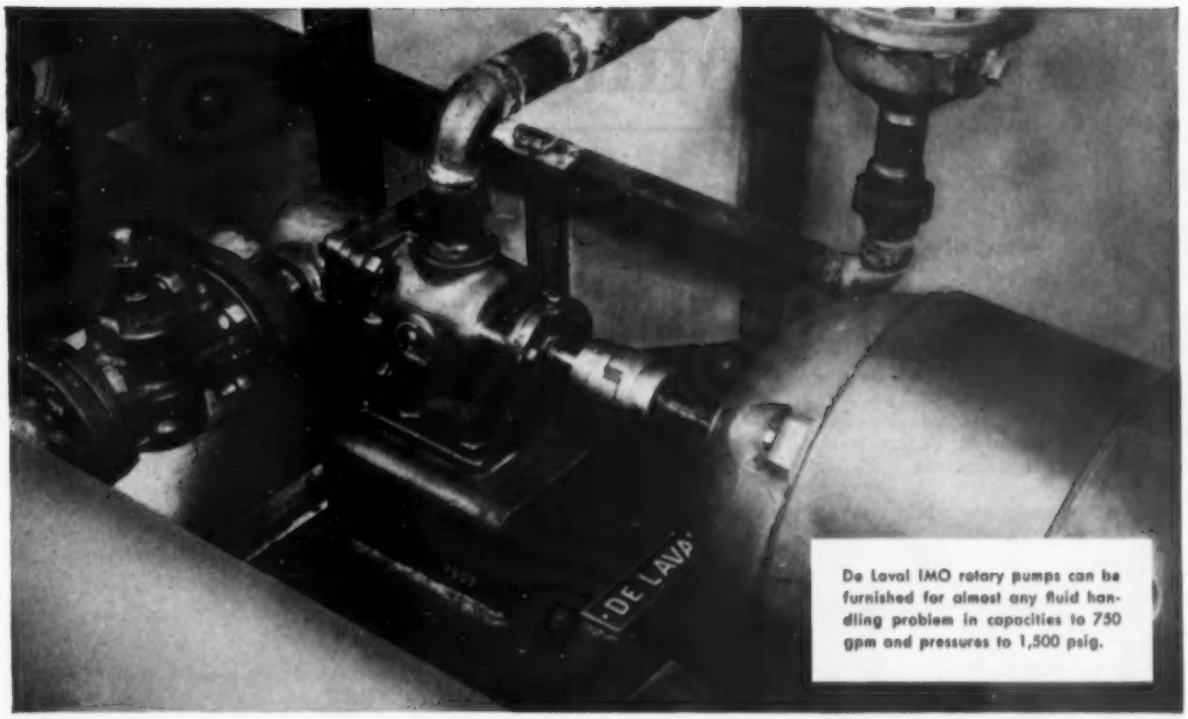
A spokesman for General Electric comments that 65 percent of all new generating installations in this country will be atomic by 1980.

Department store for atomic energy

American Machine & Foundry Company announces that it "plans to become the industrial department store for atomic energy equipment." The firm has formed AMF Atomics, Inc., as a wholly owned subsidiary to carry forward this policy . . . . Foster Wheeler announces that it is ready, now, to design and build (for completion by 1960-1961) an advanced type of nuclear power plant at a cost that will be competitive with some present-day power station costs. They are quoting a 100,000 kw (electrical) plant at just $21,000,000 . . . . Leeds and Northrup Company announce that they have delivered the first "packaged" system ever fabricated for the control of a nuclear reactor . . . . The first retail showplace selling only atomic instruments opened its doors a few weeks ago in New York.

New access to nuclear information

A new program has been announced by the AEC under which organizations or individuals may be given access to non-military confidential and secret restricted data on atomic energy technology for their own private purposes. Under the new program, non-military information which is classified as "confidential, restricted data," may be made available to any person who can evidence a potential use or application of the information in his business, profession, or trade.



De Laval IMO rotary pumps can be furnished for almost any fluid handling problem in capacities to 750 gpm and pressures to 1,500 psig.

What to Look for in a Rotary Screw Type Pump

By W. J. MONCON, *Assistant Chief Engineer*
De Laval Steam Turbine Company

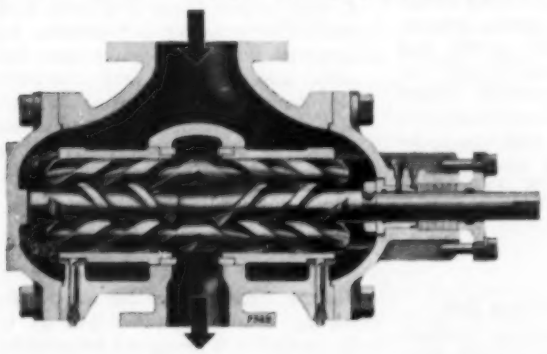
A sound knowledge of design, and how it affects performance, is the best insurance a buyer can have that he will get the pump he needs. This brief analysis of the IMO, a rotary three-screw pump manufactured by the De Laval Steam Turbine Company, will give you some of the necessary facts.

What qualities should you look for in a rotary type pump? It must, of course, meet specified capacities and pressures. But, it must also be efficient, operate quietly, stay on the job.

The axial flow of a screw type pump, and the resulting low inlet losses for any given pump speed, are important benefits that should be considered in making pump selections. The absence of timing gears and other mechanical features of construction also enable the De Laval IMO pump to operate at direct-connected motor and turbine speeds . . . to handle viscous liquids and high suction lifts.

One of the most important features of the IMO pump is the hydraulic turning of the idler or sealing rotors. The central or power rotor is the pumping element; the liquid pumped turns the sealing rotors.

A screw type pump is well suited for applications where pulsation-free flow is desirable. The axial flow of the liquid without trapping and the unique thread form which keeps closures fluid-tight contribute to quiet operation of the IMO pump.



De Laval IMO Series A322A, a positive displacement, rotary screw type pump, can handle capacities to 750 gpm and pressures to 150 psig.

Catalog LS gives useful application and specification data on the IMO pump. An article titled, *Rotary Pumps, Basic Considerations in Their Application*, contains a description of rotary pumps in general. For these publications, write on your company letterhead to De Laval Steam Turbine Company, 857 Nottingham Way, Trenton 2, New Jersey. DL-201

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new equipment

. . . for industry & power

NOTE—Each new equipment item has a key number for your convenience in asking for additional, detailed information. Circle this number on reply card, facing page 81.

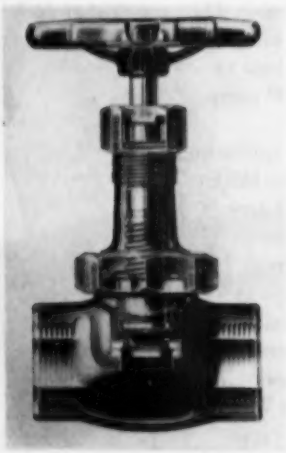
F10-Redesigned Unit Substations

Redesigned unit substations, having secondary voltage 5 kv or less, permit easier handling and greater convenience in operation. Feature meters, recording instruments, and con-

trol panels located in a safe, dead front compartment easily accessible behind a weather-proof door. Tap-changing indication and operation counter have been brought down to eye level and the tap-changing control panel and indicator are mounted next to each other. ALLIS-CHALMERS MANUFACTURING COMPANY.

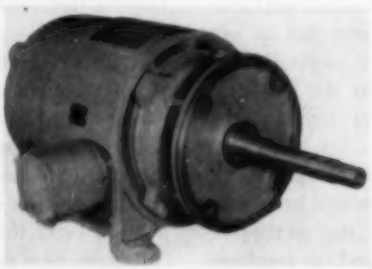
F11-Leakproof Globe Valve

Revolutionary bronze globe valve—the LQ600—has never failed or leaked during four-year test in dozens of installations—even where other valves had been replaced regularly from month to month. This record is made possible by a combination of a new seating metal, "Brinalloy," and the flat-seat design of the valve. This flat-seat type valve is suitable for throttling service since the alloy is so resistant to wear and corrosion that wiredrawing is eliminated. Seats and discs do not require replacement, renewing, or regrinding. LUNKENHEIMER COMPANY.



F12-Close-coupled Pump Motors

Close-coupled pump motors, totally-enclosed and explosion-proof, are specifically designed for use with centrifugal pumps operating in dangerous, damp, or dusty locations. Available in ratings ranging from 1½ to 25 hp. Special features include a face-type registered mount-



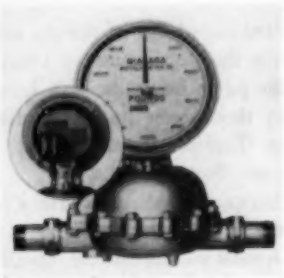
ing bracket for accurate shaft alignment and simplified pump mounting; precision ground shaft; and solid flange and brass slinger for complete liquid deflection. Other features include asbestos-protected windings, normalized castings, Lubriflush lubrication of bearings and solid cast rotors. U. S. ELECTRICAL MOTORS, INC.

F13-Alkalinity Reducer Uses Salt

Ion exchange dealkalizer utilizes principle of salt splitting as an effective means of reducing alkalinity in boiler feedwater and process water. Dealkalizing provides continuous water treatment under pressure and no pumping is required. The process is semi-automatic but can be made completely automatic by the use of a meter on the effluent and an electrically operated valve. The unit is available in a wide range of sizes, suitable for chemical plants, textile mills and medium size power plants. COCHRANE CORPORATION.

F14-Explosion-proof Liquid Meter

Explosion-proof meter for measuring liquids in hazardous atmospheres consists of a standard Niagara meter plus a register containing an electric switch. Switch completes an electric circuit after the passage of a predetermined quantity of liquid through the meter. Carries Underwriters' Laboratories listing for use in haz-



ardous atmospheres, Class 1, Group C and D and Class 2, Group E, F and G. The meter is available for use with water and water-base liquids, oils, solvents, and corrosive chemicals. Electric control imposes almost no friction load on the meter works to impair length of life or accuracy. BUFFALO METER CO.

F15-Portable Electric Tube Cleaner

Electric tube cleaner for air conditioning condenser tubes (⅝ in. to ⅞ in. O.D.) is designed for simple, rapid removal of algae, slime, and

(more new equipment on page 12)

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In Water Conditioning

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This *complete* engineering service is another reason why Betz *continues* its leadership in providing sound engineering on all water problems. It will pay you to talk with a Betz District Engineer today. No obligation, of course.

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BETZ

CONSULTANTS ON INDUSTRIAL WATER PROBLEMS

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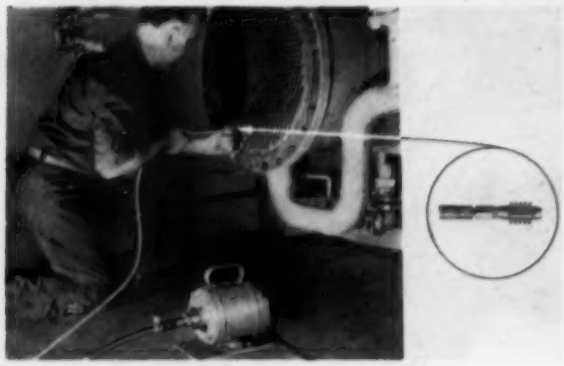
new equipment

. . . starts on page 10

mud deposits. Its use immediately reduces condenser head pressure. This AB Cleaner is powered by ¼-hp 3450 rpm motor. Available in 110/220 volts ac, single-phase only. It is both lightweight and portable. An expanding scraper instead of an expanding brush is available for use on particularly hard deposits. THOMAS C. WILSON, INC.



F16-Pen-type Lubricator

Pocket-size lubricator dispenses a drop of oil at a time. The Oil Mate is a leak-proof, lifetime-guaranteed instrument designed for oiling small tools and appliances. The oiler is made of Tenite. Fingertip pressure on the plunger atop the Oil Mate dispenses the oil in drops or dabs exactly where needed. The needle-like dispenser is small enough to fit

into minute openings. The pen will dispense oil of any viscosity and transparent barrel shows how much oil the pen contains. A convenient pocket clip enables the Oil Mate to be carried like a pen. Price is $1.98 each. Owner's name imprinted in gold for just 25¢ additional cost. GRAY'S LIMITED.

TO REQUEST ADDITIONAL DATA

Circle key numbers on reply card facing page 81. Your requests will be handled promptly.

F17-Portable Oxygen Analyzer

Portable oxygen analyzer provides direct measurement of oxygen content without catalysts, chemicals, filaments, or glassware. The Model C2P oxygen analyzer is particularly designed for quick, simple, accurate measuring. It is portable, and can be

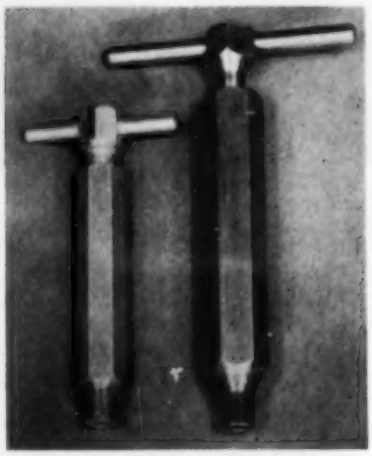
used for measuring continuously-flowing samples or for fixed volume samples as small as 3 cc. Available in any range of 5 percent or more between 0 and 75 percent oxygen and in ranges of 15 percent or more between 75 and 100 percent oxygen. ARNOLD O. BECKMAN, INC.

F18-Ready-Made Standard Solutions

Standard low-silica solutions are now available to industry to simplify the establishment of a demineralizer control laboratory. They are prepared and analyzed in accordance with the methods published by the Joint Research Committee on feedwater studies and the Armour Research Foundation. The need for low-silica standards arises because conventional industrial chemical laboratories are not set up for preparation of such standard solutions. COCHRANE CORPORATION.

F19-Simple Stuffing Box Lubricator

Stuffing box lubricator simplifies packing pump shaft stuffing boxes. Previously made up for individual customers at their request, the lubricator is now available as a stock item to meet the heavy demand from pump users. Available in brass or



cadmium-plated steel, the new accessory comes in two overall lengths: 6⅜ in. and 8-7/16 in. The lubricators are equipped with N.P.T. thread connectors. MOTOR AND VALVE DIVISION, ROCKWELL MANUFACTURING COMPANY.

F20-Smaller Magnetic Starter

NEMA size 4, magnetic starter is 40 percent smaller than previous models of the same rating. New starter is designed for motors up to 100 hp, and is the same size and has the same mounting dimensions as the Size 3 model. Strong-box coil design includes a tough, cast-on plastic case for maximum protection of coil windings. New bimetallic

(more new equipment on page 14)

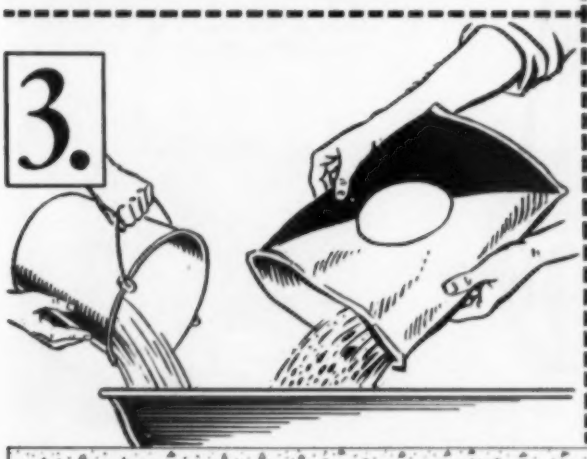
1.

WATER

2.

CASTABLE REFRACTORY

3.



4.

REFRACTORY CONCRETE

is easy to make with a Castable Refractory

Just add water to a packaged castable, mix, and you're ready to place refractory concrete. Castable refractories supply you with the right combination of selected aggregates and Lumnite* calcium-aluminate cement carefully proportioned to meet the heat resistance and insulation requirements of many jobs.

Chances are this convenient way to make Refractory Concrete can speed work and cut costs on your next refractory job. Why not keep a few bags on hand—you'll have "two strikes" on your next emergency repair! Castables are made and distributed by manufacturers of refractories.

Refractory concrete made with castables is the *adaptable* refractory—can be easily placed in any size or shape . . . resists severe thermal shock and spalling. It can be poured, troweled or "shot" on by cement gun, and it's ready for service in 24 hours or less.

For additional information, write Lumnite Division, Universal Atlas Cement Company, (United States Steel Corporation Subsidiary), 100 Park Avenue, New York 17, N. Y. or contact any of the offices shown below.

OFFICES: Albany • Birmingham • Boston • Chicago • Dayton
Kansas City • Minneapolis • New York • Philadelphia • Pittsburgh
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*"*LUMNITE" is the registered trade-mark of the calcium-aluminate cement manufactured by Universal Atlas Cement Company.*

IP-L-94

ATLAS® **LUMNITE for INDUSTRIAL CONCRETES**

REFRACTORY, INSULATING, OVERNIGHT, CORROSION-RESISTANT

UNITED STATES STEEL HOUR—Televised alternate weeks—See your newspaper for time and station

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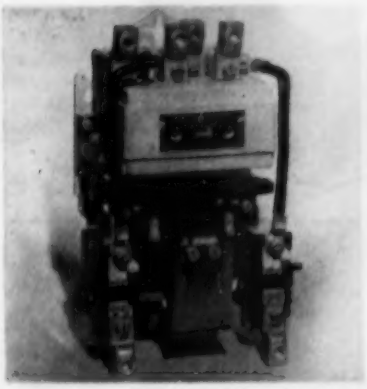
new equipment

. . . starts on page 10



overload relay provides overload protection comparable to that available in smaller sizes. The starter is suitable for operation of polyphase motors in ratings of 220 or 440/550 volts at 100 horsepower. Available in reversing, multispeed, and combination forms. GENERAL ELECTRIC COMPANY.

F21-Steeple-type Gear Reducers

Worm gear reducers have been successfully used in a wide variety of applications. These drives were especially developed for vertical drives that call for sturdy, reliable speed reductions. Wide bearing span insures extreme rigidity for unsupported shaft extensions. "Dry-well" construction eliminates a stuffing box on the vertical shaft. PHILADELPHIA GEAR WORKS.

F22-Steam-Hot Water Generator

Combination steam-hot water generator for industrial use is basically a hot-water generator with a few simple adjustments to quickly convert it to steam. Operates completely automatically once the type of operation is selected. Unit operates on light oil, gas, or a combination of both. It is rated as 60-hp, steam or hot water generator. As a hot water generator it will deliver 2,480 gallons of hot water per hour with a 100 degree rise in temperature. As a 60-hp steam generator, the unit delivers 2,070 pounds of steam per hour, and operating pressures range from 15 to 200 psi. In changing over from hot water, the unit will deliver steam in five to ten minutes. CYCLOTHERM DIVISION, U.S. RADIATOR CORPORATION.

MODERN COAL AND ASH HANDLING SYSTEMS FOR MODERN PLANTS INCLUDE

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Coal stays dry, doesn't freeze, doesn't deteriorate. Expensive compaction operations required by outside storage are eliminated. *Kalamazoo* first cost is the *only* cost—no maintenance needed.

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Kalamazoo coal storage silos at large midwestern hospital.

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Kalamazoo TANK and SILO COMPANY

641 HARRISON STREET KALAMAZOO, MICH.

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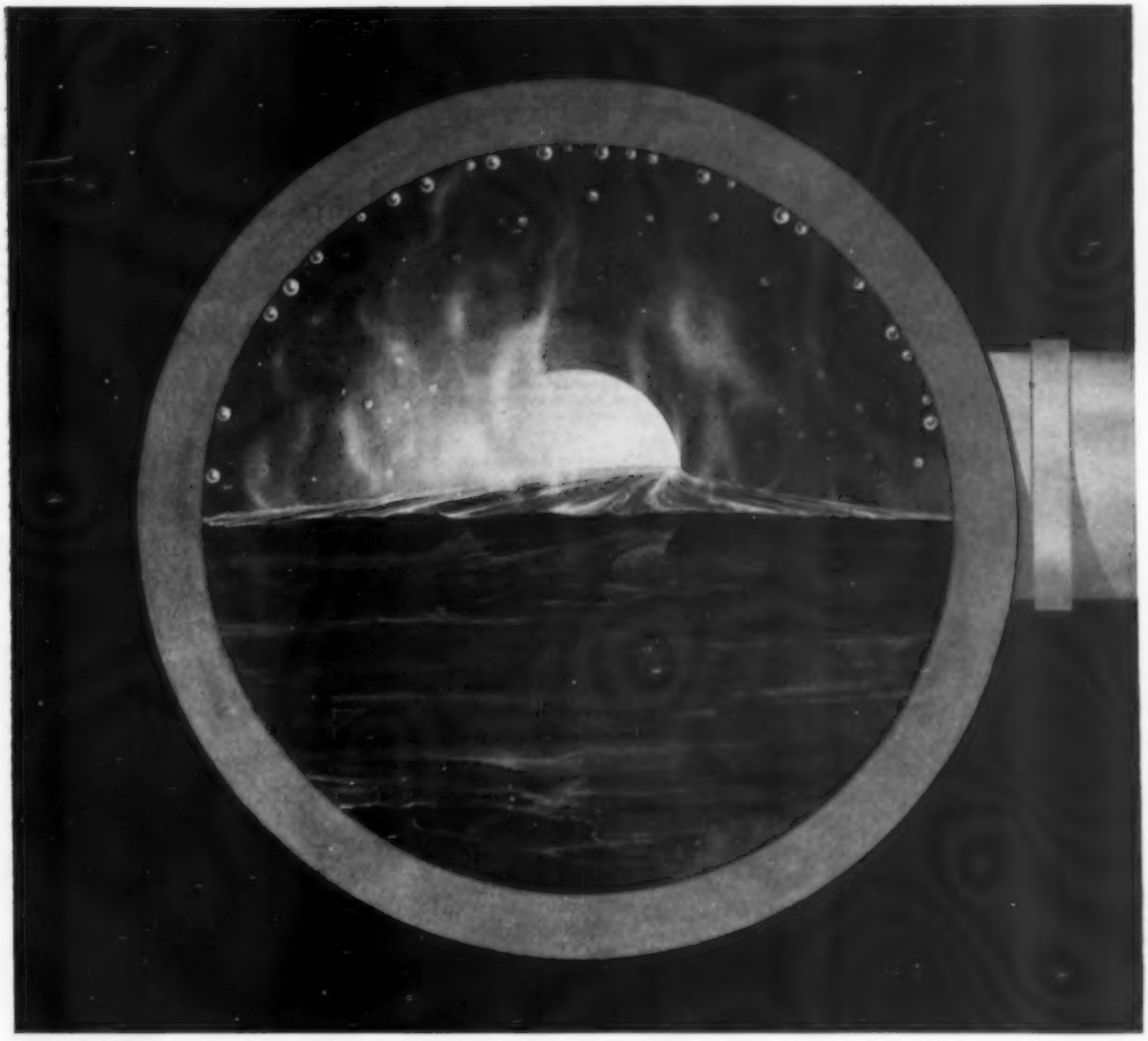
F23-Wet Surface Protective Coating

Aluminum coating product effectively prevents corrosion of dark surfaces that are damp, wet, or sweating. Non-toxic in all respects, it is ideally suited for coating tanks containing drinking water. Its bright color eliminates the problem of surface areas that are partly missed in covering. The aluminum coating

(more new equipment on page 18)



WHAT'S A MONOMOLECULAR FILM?

It is a film one molecule thick. Filmeen* in steam or condensate lines produces a monomolecular film.

But, there's a lot more to it than thickness. The film's most important function is protection against corrosion. By forming a nonwettable coating on all metal surfaces with which treated steam or condensate come in contact, Filmeen provides a protective, corrosion-inhibiting barrier between water and metal. In heat exchange equipment, the condensed steam treated with Filmeen then forms as spherical drops of water which resist adherence to the film surface, much the same as a drop of water will form into a small ball on a waxed surface. This phenomenon results in increased rate of heat transfer—which in turn saves money in power plant operation.

When steam condenses on untreated return lines, it forms a continuous layer of water that restricts heat transfer. You don't want that... it raises the cost of heat.

Your Dearborn sales engineer will gladly explain how Filmeen can keep your heating costs in line.

**Filmeen is the trade-mark of a corrosion-inhibiting compound produced exclusively by Dearborn Chemical Co. U.S. Pat. No. RE 23614.*

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a leader in water conditioning and corrosion control

Dearborn Chemical Company
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Please send me complete information about Filmeen.

Name.....*Title*.....

Company.....

Address.....

City.....*Zone*.....*State*.....

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new bulletins

. . . for industry & power

200-Step-saving Insulation

The properties of Duraface Foamglas—unique cellular glass insulating material that combines both insulation and ceramic finish in a single unit — are discussed in Bulletin DF-100. Now, a wall can be completely insulated and surface-finished in one operation. The material is resistant to nearly all chemicals. Four pages. Pittsburgh Corning Corporation.

201-Floor Preparation Chart

Complete program for better floor care will give more safety and longer lasting floors. Complete line of equipment is described. Chart describes 24 floor preparations. It describes what they are, where they should be used, and gives their coverage. Eight pages. Multi-Clean Products, Inc.

202-Low-voltage Air Breakers

Low-voltage dead-front breakers with positive displacement trip devices in ratings of 600 volts ac, 40 to 1,600 amperes continuous, and 25,000 to 50,000 rms amperes interrupting capacity are described in Bulletin 18B8252. Typical thermal trip curves are included. Six pages. Allis-Chalmers Manufacturing Company.

203-Modern Lines In This Exhauster

Detailed information and performance tables of new Axial Mushroom Power Room Exhausters are contained in Bulletin CAM-102. The exhausters are aerodynamically designed to reduce turbulence and discharge losses to a minimum. Yet they have an extremely low silhouette so that they blend with contemporary building design. They operate with or without duct systems and can function as fresh-air supply units by reversing direction of air flow. Chicago Blower Corporation.

204-Control Selection Guide

Bulletin F 6149-2 has a complete explanation of the various types of temperature control systems available. It answers the question of where to use each for best results. Control terminology, and rules for selection of a proper method of control are included. Eight pages. Wheelco Instruments Division, Barber-Colman Company.

205-Diesel, Gas Engine Data

This publication describes Power Chief diesel and gas engines. It shows installation views along with specifications and pertinent data. Both types of engines are available with stub shaft or clutch power take-off and as engine-generator sets. Twelve pages. Nordberg Manufacturing Company.

206-How Traps Need No Maintenance

A 60-day trial installation is offered in a revised bulletin describing new thermodynamic steam traps. It also explains why practically no maintenance is required. Trap features only one moving part, of solid stainless steel, and has the same head and seat for pressures up to 600 psi. Four pages. Sarco Company.

207-Simple Low-cost Refrigeration

Operation of complex absorption refrigeration cycle is explained in four simple steps in Catalog 16B7. Models range from 100 to 700 tons capacity, occupy minimum space, and are lighter than conventional units. Units adjust automatically from maximum load down to zero capacity. In the event of overload, they will continue to operate without harm to the machine. Physical characteristics and capacity ratings are listed in easy-to-read tables. Thirty-six pages. Carrier Corporation.

208-Air Efficiency Check List

It pays to survey the cost of a compressed air system. Bulletin 711 includes a fill-in type check list to help analyze effectiveness of the present aftercooler. Also contains a chart covering moisture content of air and cut-away illustrations of aftercoolers, cyclone separators, and air filters plus size and capacity charts for these units. Twelve pages. R. P. Adams Company.

209-Self-bonding Tape Application

Detailed performance and application information on self-bonding insulating tape, electrical filler tape, electrical jacketing tape, high voltage splicing tape, and general-purpose vinyl electrical tape is given in Bulletin 455. Physical, chemical, and electrical properties are tabulated. Eight pages. Bishop Manufacturing Corporation.

210-How To Use Magnetic Equipment

Magnetic separators protect machinery from damage by tramp iron, prevent product contamination, and can eliminate fire hazards. New brochure describes how magnetic ideas have been applied with engineering know-how. Over a hundred uses for permanent magnets are given. Twenty-four pages. Eriez Manufacturing Company.

211-Package Pump With Seal Choice

Pump units in capacities to 2,500 gpm, heads to 400 feet, and temperatures to 250 F described in Bulletin 52B6083C. The pumps are easy to install, need no special foundation, and require less maintenance. Alternate sealing arrangements are described, and engineerng data are tabulated. Six pages. Allis-Chalmers Manufacturing Company.

212-Multi-V-belt Drive Simplified

A Multiple V-drive moulded as a single unit, running on matching sheaves, and combining the advantages of V-belts with the simplicity of flat belts is described in Catalog PV-200. Specifications on the stock sizes of sheaves and belts are presented with engineering data for design of drives. Tables of practical stock-drive combinations are already worked out for convenient selection. Thirty-six pages. Browning Manufacturing Company.

213-Lubrication Wall Chart

Handy wall chart containing lubrication recommendations for many industrial needs covers such applications as hydraulic systems, spindles, air compressors, transmissions, motors, and conveyors. Printed on tough varnished stock, this two-color chart will help eliminate lubricant misapplication. E. F. Houghton & Co.

214-Pump Turbines Prove Economical

Progress report tells how pump-turbines are proving to be an economical way to smooth load curves by providing off-peak load and peak-load power. Brochure 02R8245 is a reprint from the **Allis-Chalmers Electrical Review**, and explains how the electrical half of a reversible pump-storage unit differs from a normal hydrogenerator. Twelve pages. Allis-Chalmers Manufacturing Company.

215-Cooling Tower Corrosion Control

Discussion of how chemical and bacteriological attack can be controlled by acid treatment and wood preservatives to kill fungi appears in Technical Paper No. 130. A good reference work for anyone interested in cooling towers. Eight pages. W. H. & L. D. Betz.

216-Infinitely Variable Speed

Infinitely variable speed transmission provides extremely accurate adjustment above and below input speeds. This compact unit gives all speeds to zero, and even goes into reverse without stopping the

(more new bulletins on page 20)

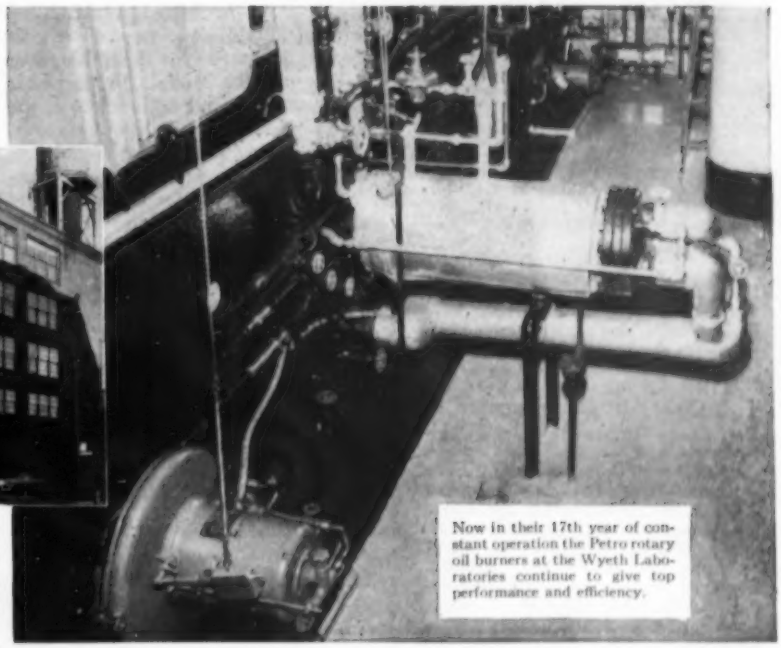
NOTE — Each new bulletin item has a key number for your convenience in asking for a free, personal copy. Circle key numbers on Reply Card facing page 81.

Petro Industrial Oil Burners

PAID FOR THEMSELVES DURING THE FIRST YEAR

for the

WYETH LABORATORIES, INC.
Philadelphia, Pa.



Now in their 17th year of constant operation the Petro rotary oil burners at the Wyeth Laboratories continue to give top performance and efficiency.

"Petro oil burners saved us $6,349 on fuel the first year—and in addition we enjoy better heating and more horsepower from our boilers," says E. C. Beeler, Plant Engineer.

FUEL SAVINGS JUST DON'T HAPPEN —there has to be a reason—and the Petro "Thermal Viscosity System" is the reason Petro equipment owners all over the country save thousands of dollars every year! It's a simple, foolproof fuel preheating system which lowers the viscosity of the low-cost, heat-rich heavy oils and enables users to burn them with complete reliability.

Here's how it works

To properly fire No. 6 oil, the oil must be *warmed* so that it will thin out and ignite easily and atomize efficiently. To accomplish this vital need Petro burners have a magnetic valve which is controlled by the oil temperature and will not admit oil to the rotary atomizing cup until it is warm enough to fire properly. The oil is circulated through automatic heaters until the proper temperature is reached. Heaters are of ample capacity to supply warm oil for any firing need.

Thus Petro oil burners assure owners (1) accurate metering of oil (2) fine, thorough atomization (3) quick starts, no smoky fires (4) no slug of cold oil in lines to cause faulty starts.

No manual attention is required

The entire operation is automatic. There are no involved mechanical controls requiring adjustment or maintenance.

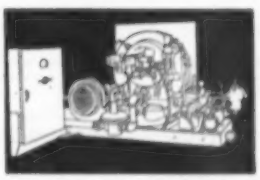
Saves labor costs—saves fuel costs

Why don't you find out how much Petro industrial oil burners can save for you? They are quickly adaptable to nearly every existing boiler. Send in the coupon for full information.

OVER 50 YEARS OF LEADERSHIP IN AUTOMATIC HEATING AND POWER EQUIPMENT

PETRO

T.M. REG. U.S. PAT. OFF.



COMPLETE PACKAGED UNIT

A complete forced draft combustion system with all parts factory assembled and tested. Saves installation time and cost, gives top performance and fuel economy.

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NATIONAL AIROIL

Oil Burners

OF THE STEAM AND MECHANICAL TYPES NOW COMBINED INTO

Dual Stage BURNERS

Now, at last, the inherent advantages of *both* systems of fuel oil atomization are *profitably* yours . . . within the one, new NATIONAL AIROIL Dual Stage Burner.

43 years of combustion equipment design and manufacture are in back of the Dual Stage Oil Burner . . . and, it has been thoroughly tested and proved in the field for firing: Petroleum Processing Heaters; Rotary Kilns; H.R.T., Scotch Marine and Water Tube Boilers; etc.

Available in three sizes, the NATIONAL AIROIL Dual Stage Burner fires all grades of fuel oil from No. 2 to No. 6, with a ready capacity of 80 to 300 g.p.h. Further, for a perfect flame pattern, we would recommend using with the Dual Stage Burner either the NATIONAL AIROIL Universal Register for forced draft or, the NATIONAL AIROIL Tandem Unit for natural or induced draft furnaces.

Get detailed description, illustration, and specifications in NATIONAL AIROIL Bulletin 25.

OIL BURNERS and GAS BURNERS for industrial power, process and heating purposes
STEAM ATOMIZING OIL BURNERS
SLUDGE BURNERS, Steam Atomizing
MOTOR-DRIVEN ROTARY OIL BURNERS
MECHANICAL PRESSURE ATOMIZING OIL BURNERS
DUAL STAGE, combining Steam and Mechanical Atomization
LOW AIR PRESSURE OIL BURNERS
AUTOMATIC OIL BURNERS, for small process furnaces and heating plants
GAS BURNERS
COMBINATION GAS & OIL BURNERS
FUEL OIL PUMPING and HEATING UNITS
FURNACE RELIEF DOORS
AIR INTAKE DOORS
OBSERVATION PORTS
SPECIAL REFRACTORY SHAPES

Established 1913 — *Incorporated 1917*

NATIONAL AIROIL BURNER COMPANY, INC.

1391 E. Sedgley Ave., Philadelphia 34, Pa.
S. W. Division: 2512 So. Blvd., Houston 6, Texas

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new equipment

. . . *starts on page 10*

makes inspection easier in poorly illuminated areas. It permits thicker coatings than are possible with black products without excess material coming off during use. XZIT CHEMICAL COMPANY.

F24-Heavy-duty Atomizing Burners

Heavy-duty pressure atomizing oil burner, with a capacity of 20-30 gallons, is approved for firing No. 2 or lighter oil. The Model C-3 burner is designed to permit adjustment of the nozzle position while the burner is in operation. This allows setting of the burner for maximum combustion efficiency and for the most suitable flame shape. IRON FIREMAN MANUFACTURING COMPANY.

TO REQUEST ADDITIONAL DATA

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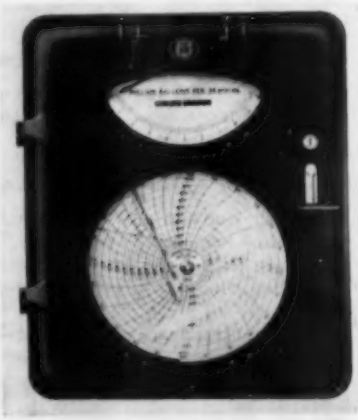
F25-Remote Recording Instruments

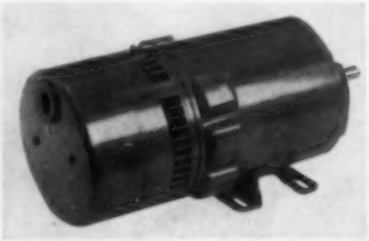
Remote electrical transmission instruments for use where accurate transmission of flow or other measurable data is required can transmit data over private wires in the plant



or over leased telephone channels for many miles. The system may be applied for the transmission of flow, liquid level, or pressure data. It can be installed in explosive-proof locations. Transmitting units may be applied to mercury cylinders of varying sizes to produce measurements over 4 to 1, 10 to 1, 13 to 1, 18.5 to 1, and 20 to 1 ratios—with errors not exceeding ± 2 percent at any point over these ranges. SIMPLEX VALVE AND METER COMPANY.

F26-Fractional Hp Brake Motor

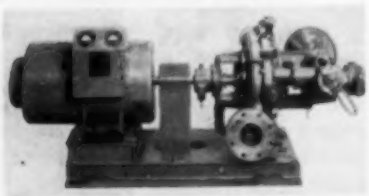
Fractional horsepower brake-motor is totally enclosed and fan-cooled. Operates overhead doors, cut-off mechanisms, small elevators, and for other loads where positive stopping or holding in position is desired. The brake fits General Electric's new small-size Form G motor, resulting in a compact lightweight



unit. Combined manual release and wear indicator is recessed in the brake housing for quick, visual inspection. A large finger recess permits manual release even by an operator wearing gloves. In the event of power failure, it automatically sets, giving added protection. Available in ¼, 1/3, ½ and ¾-hp at 1725 rpm. GENERAL ELECTRIC COMPANY.

F27-Packaged Turbine Generators

Packaged a-c turbine-generators for emergency light are compact, ready-to-be-installed units and require no switchboard. Ratings from 3.75 to 62.5 kva are available. Units consist of a type TF steam turbine with



constant speed governor, excess speed safety trip, carbon ring glands, relief valve, and steam strainer. Turbine is connected by a Falk flex-

...of all these ELGIN Water Softener features...

- which do you consider most important?

1 DELIVERS UP TO 44% MORE SOFT WATER. The ingenious "Double-Check" manifold system permits a *deeper* zeolite bed, which delivers as much as 44% more soft water than water softeners of conventional design and equal size. No stretching your supply to the danger point!

2 ZEOLITE LOSS PREVENTED. "Double-Check" manifold also prevents loss of expensive zeolite during backwash period. A *real* money saver, with zeolite costs as they are!

3 REQUIRES LESS SPACE. To deliver a soft water output to equal Elgin's, *any* other water softener would have to be 44% bigger. Elgin lets you take advantage of limited space!

4 BETTER BACKWASHING. "Double-Check" design provides better, more thorough backwashing which keeps zeolite clean, active and more receptive to salt regeneration. This assures peak operation year after year!

5 LOWER OPERATING COSTS. Better service means lower costs in the long run! With cleaner, more active zeolite, regeneration takes less salt and wash water.

6 LOWER MAINTENANCE COSTS. Heavy duty construction throughout offers you greater permanence with an Elgin Water Softener. Combine that with the zeolite-saving, more efficient "Double-Check" manifold system, and you get lower overall maintenance costs and added years of service!

7 MORE ECONOMICAL TO BUY. Even though the Elgin Water Softener provides all these outstanding features, when you figure cost per thousand gallons of soft water delivered, lower maintenance cost and time saved, you'll find it your most economical buy.

Elgin offers you a complete line:

MANUAL • PUSH-BUTTON AUTOMATIC • FULLY AUTOMATIC

Equally advanced in design are other Elgin Ion-Exchange Systems which provide Alkalinity Reduction, Deionization, Silica Removal and Hot Zeolite Softening.

Write or call us for further information concerning your water conditioning needs . . . or better still, let us put our near-by representative in touch with you!

ELGIN SOFTENER CORPORATION

ELGIN-REFINITE DIVISION

138 North Grove Avenue, Elgin, Illinois

ION EXCHANGERS • FILTERS • DEAERATING HEATERS • DEALKALIZERS • DEGASITORS • LIME SOFTENERS • CHEMICALS

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new bulletins

. . . starts on page 16

motor. Its principle and mechanism are described in detail. Wide choice of controls is illustrated. Bulletin 519 includes complete engineering specifications. Eight pages. Graham Transmissions, Inc.

217-Compressor Needs Less Hp

Unique design of ATH compressors simplifies maintenance and reduces horsepower requirements by improving heat transfer and allowing compressors to operate at below-usual temperatures. The sectionalized cylinders are shown in detail in Bulletin 601, which discusses the advantages of this development. Available sizes, capacities, and ratings are tabulated. Six pages. Pennsylvania Pump and Compressor Company.

218-Selecting Liquid Level Controls

Engineering data on the choice of proper bulb and instrument, plus installation information on liquid level telemetering and remote control are given in Bulletin L701. Float, pressure, differential pressure, and bubbler-type liquid and water level gauges in strip and round-chart models are shown. Also included are a time-liquid level program controller and new miniature graphic-panel pneumatic transmission instrument for liquid level measurements. Twenty-six pages. The Bristol Company.

219-Internal Telephone Benefits

The benefits of an internal telephone system are shown by means of a case history, with a discussion of the problems involved and their solution. General specifications of the equipment are listed and illustrated in Report 105. Four pages. Automatic Electric Sales Corporaton.

220-Waste Disposal Equipment

Basic types of equipment available and the advantages of industrial waste treatment are discussed in Brochure WC-117. Photographs and typical installations are included. Four pages. Graver Water Conditioning Co.

221-More Compact Type H Motors

Manufacturing developments and improved electrical characteristics make the new Type H motor more compact than previous models. Multicolor Bulletin 1856 shows cutaway views of the new Uniclosed motor. It points out that the new Type H conforms with new NEMA specifications. Twelve pages. U.S. Electrical Motors, Inc.

222-Where To Look For Air Faults

Choked intake filters, poorly designed suction pipes, overcooling, undercooling, inadequate distribution mains and wet air add up to expensive compressed air and high maintenance costs. Bulletin 520-A is a handbook with hook-up sketches to help users of compressed air to improve their installations. Features cooling controls, drain traps, electric thermostats, and pressure switches. Eight pages. Sarco Company.

223-Portable Oil Maintenance

New portable line of oil filters makes possible on-the-spot maintenance of lubricating and industrial oils. Bulletin 316 also includes information, illustrations, and references about combination oil filters and reclaimer units. These units are ideal for filtration and vacuum vaporization of water and other volatile contaminants in turbine, diesel, transformer, transmission and hydraulic oils. Four pages. The Hilliard Corporation.

224-Coaxial Speed Variator

This new speed variator is a simple, compact drive that provides infinitely variable output speed. An improvement on a European design, this unit has been intensively tested in the field. Efficiencies of 75 to 90 percent are easily maintained. Bulletin K-100 describes how the unit works and lists its advantages and properties. Engineering data are included. Four pages. The Cleveland Worm and Gear Company.

225-Hp Component Tables For Controls

Information comparing applications and merits of manual and magnetic control and across-the-line and reduced-voltage control is presented in Catalog GEC-1260A. Photographs, prices, wiring diagrams, and dimensions on motor starters and controls are included. Includes a special section correlating components for each type of motor control application by hp. Sixty-eight pages. General Electric Company.

226-Choosing Air Conditioning Pump?

Wide selection of monobloc centrifugal pumps used in air conditioning systems, their ratings and capacities for refrigeration tonnages are listed in tabular form in Bulletin W-306-B3B. A chart provides information on horsepower, weight, sizes, types, and prices. Drip-proof motor dimensions are listed along with corresponding frame and pump sizes. Worthington Corporation.

227-Revised Insulation Manual

Second edition of this manual contains an explanation of the chemical and physical properties of 85-percent magnesia, together with new conductivity, density, and fire-resistance data. Water-resistant magnesia insulation for underground conduits and other wet locations is described. Tables include the new simplified thicknesses manufactured for pipe size up to 24 inches. Heat loss tables have been recalculated. Seventy-four pages. The Magnesia Insulation Manufacturers Assoc.

228-Close-coupled Pump Index

Close-coupled motorpumps from ¼ to 75 hp, for delivery of 5 to 2800 gallons per minute, are covered in Bulletin 7093-E. Visual and concise index shows basic classifications and their specifications. Each class is explained and illustrated in detail. Modifications that can be made to standard units are shown and pipe friction tables are included. Twenty-four pages. Ingersoll-Rand Co.

229-Open Bearing Lubrication

Adequate lubrication of open bearing surfaces is now practical through use of a simple, sure, and inexpensive system for spraying grease and oil. Powered by compressed air, grease or oil can be sprayed onto any desired area in any amount at any interval. Includes engineering drawings. Four pages. The Farval Corporation.

(more bulletins on page 72)

new equipment

. . . starts on page 10

ible coupling to packaged 1800-rpm generator with direct-connected exciter and mounted control cabinet. COPPUS ENGINEERING CORPORATION.

F28-Tailored Multi-branch Headers

Multiple branch tee solves many header problems in the petroleum, chemical, and power fields. It can be used advantageously in the fabrication of piping for air conditioning and radiant heating systems. The tee conforms to the Code for Pressure Piping area replacement for-

mula and is especially useful where branch outlets are appreciably smaller than the run pipe. The new product is "tailored" to individual jobs—its size, wall thickness, and the number and size of the outlets are determined by individual service conditions. Available in all commercial metals and alloys. TUBE TURNS, INC.

F29-Stoker Fires Wood Refuse

Wood refuse disposal is now possible with a low-cost stoker. It can be applied through the front of an existing boiler and arranged to extract and measure fuel from a storage bin. It also can be equipped with a transfer hopper to receive fuel from present conveyor or blow pipe systems. Efficiently burns wet or dry hogged wood, planer shavings, chips, bark, and all wood refuse. The fuel is metered to suit steam requirements. It is then mixed with proportioned air in a carburetor-distributor and spray-spread on the grate. Model ZD-56 is available for use in industrial plants operating boilers 60 hp and larger and can be used in con-

(more new equipment on page 23)

COPPUS "BLUE RIBBON" VENTILATORS

identified by the blue band

FOR WORKERS'

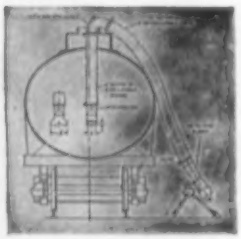
- *Safety*
- *Health*
- *Comfort*
- *Efficiency*

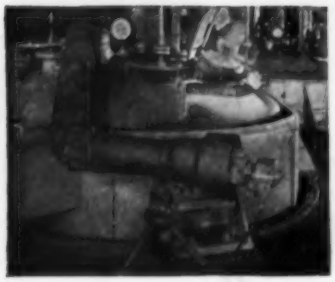
VANO Design "A" VENTILATOR

Vano Design "A" cooling interior of furnace, supplying fresh air through 10 feet of "Ventube" to provide safety and comfort during repair work.

Vano Design "A" delivering fresh air to cable manhole, expelling sewer gas, making entrance safe in a few minutes.

Vano Design "A" Ventilator plus a few accessories feeds large air volume into tank car, driving out fumes, stagnant or hot air for workers' safety and comfort.





Vano Design "A" supplying fresh air in Reactor Room of Synthetic Rubber Plant.

Vano Design "A" Ventilator supplying fresh air to men working in wing compartments, fuselages, etc.

Powered by a ½ hp motor, and equipped with the exclusive Coppus axial-flow propeller-type fan, this general-purpose blower delivers 1500 CFM of fresh air. It supplies ventilation for tanks, tank cars, drums, vats, underground cable manholes, pipe galleries, airplane wing compartments and fuselages, and other confined places. Weighs only 103 lbs. Uses 8"-diameter flexible canvas tubing ("Ventube").

VANO DESIGN "C"

VENTILATOR-EXHAUSTER

Vano Design "C" equipped with 8" discharge tubing removing welding fumes.

Vano Design "C" equipped with two suction lines removing welding fumes for operators' safety.

For withdrawing welding fumes from confined places or directly from the welding rod ... or for expelling fumes or hot air from enclosed vessels. You can get it with 8" suction inlet for 8" non-collapsible tubing ... or with multiple inlet nozzles for 5", 4" or 3" suction hose. The discharge outlet takes 8" "Ventube". Powered by a ½ hp motor, it weighs only 85 lbs.

COPPUS ENGINEERING CORP., 186 PARK AVENUE, WORCESTER 2, MASS.
Please send information on the Blowers that clear the air for Action.

- ☐ in tanks, tank cars, drums, etc.
- ☐ in underground cable manholes.
- ☐ in aeroplane fuselages, wings, etc.
- ☐ on coke ovens.
- ☐ on steam-heated rubber processors.
- ☐ on boiler repair jobs.

COOLING:

- ☐ motors, generators, switchboards.
- ☐ wires and sheets.
- ☐ general man cooling.
- ☐ around cracking stills.
- ☐ exhausting welding fumes.
- ☐ stirring up stagnant air wherever men are working or material is drying.

NAME.....

COMPANY.....

ADDRESS.....

CITY.....

(Write here any special ventilating problem you may have.)

COPPUS "BLUE RIBBON" PRODUCTS — *Designed for Your Industry, Engineered for You*

Circle 513 on reply card for more data

Three 125,000 #/HR STEAM GENERATORS by Vogt AT LION OIL COMPANY'S BARTON CHEMICAL PLANT

★ The new $30 million Lion Oil Company's Barton Chemical Plant at Luling, La. produces 300 tons daily of essential nitrogen fertilizer materials to boost crop yields and reduce unit production costs on the nation's farms.

PRINCIPAL DATA, EACH UNIT

125,000 pounds per hour capacity.

Fusion welded steam and water drums designed for 725 lbs. S.W.P.

Superheater delivers steam at 750°F. total temperature.

Water cooled furnace.

Burners for Gas and Oil fuel.

Vogt offers a complete line of custom built type and package unit type steam generators. Available in bent tube types and straight tube, forged steel sectional header types for solid, liquid, or gaseous fuel burned singly or in combination. Write for bulletins.

HENRY VOGT MACHINE CO. 75th Anniversary LOUISVILLE, KY.

Henry Vogt Machine Co., Louisville, Ky.

BRANCH OFFICES:
New York, Philadelphia, Chicago, Cleveland, St. Louis, Dallas, Charleston, W. Va., San Francisco
Circle 514 on reply card for more data

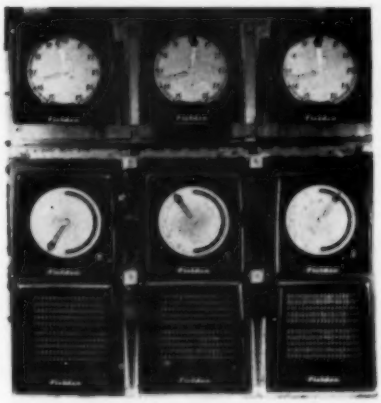
new equipment

. . . starts on page 10

junction with supplementary fuels such as coal, gas, or oil. AMERICAN COAL BURNER AND WOOD STOKER CORPORATION.

F30-Continuous Process Controller

Electronic "watchdog" makes possible continuous control of an unlimited number of industrial processes from a single vantage point. The indicating scanner monitors a variety of process variables involving level, temperature, thickness, mechanical movement, tolerance, weight, and pressure. It will keep a



steady check on 6, 12, 24, 48, or more steps in a manufacturing process. If a process strays beyond the pre-set control zone, the scanning stops at that point and actuates an alarm. Indicator dial shows the extent of the deviation. Associated control systems may automatically correct the condition. ROBERTSHAW-FULTON CONTROLS COMPANY.

F31-Self-contained Fluid Drives

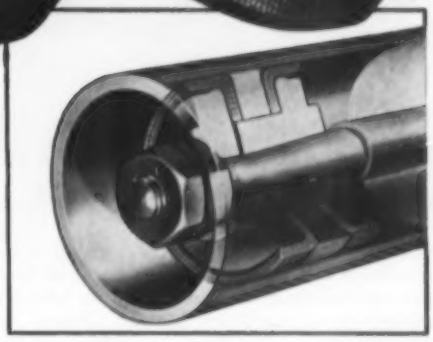
Stepless speed control, no-load starting, and excellent torque-limiting control are features of a new line of enclosed, completely self-contained fluid drives. The new units offer a wide range of speed adjustment on both variable and constant torque loads. They are designed for dual rotation so the fluid drive and load can be reversed while in motion by merely reversing input rotation. AMERICAN BLOWER CORPORATION.

PUMCUP ADVANTAGES

now yours for

- *HYDRAULIC CONTROLS*
- *AIR CYLINDERS*
- *RECIPROCATING PUMPS*

Two common Pumcup types: conventional and 45° bevel type . . . available in a complete range of sizes and texture-engineered compositions.



Cutaway view of typical Pumcup installation resulting in prolonged high efficiency.

TAKE it from experienced users, Darcova Pumcups offer payoff advantages that can't be equalled! For example, they last many times as long as ordinary piston packing . . and they *hold peak efficiency* from start to finish. Because of the resulting production and maintenance economies, plant after plant is standardizing on Pumcups.

Improved application of the cup principle does the trick. And Darcova Pumcups are *texture-engineered* in *a range of compositions* to meet most temperature-pressure-fluid conditions. And they are available in sizes and types exactly right for your particular equipment.

It will pay you to get *all* the facts. Just ask for Pumcup Bulletin No. 5503.

DARLING VALVE & MANUFACTURING CO.
Williamsport 9, Pa.

DARCOVA
THE ORIGINAL CONFOSHION CUP
TRADE MARK
PUMCUPS

Circle 515 on reply card for more data

ideas in action

. . . for industry & power

Pumps Sealed With A Weld

To insure against any possibility of leakage from special pumps for atomic energy installations, Allis-Chalmers is supplying pumps that can be welded shut upon installation. The units need no lubrication, and are cooled by an auxiliary blower. Pump parts are type 347 stainless steel, and the pump motor is silicone insulated. They need no lubrication. They are rated 15 gpm at 500 F against 35-foot head, operating at pressures up to 2,000 psig.

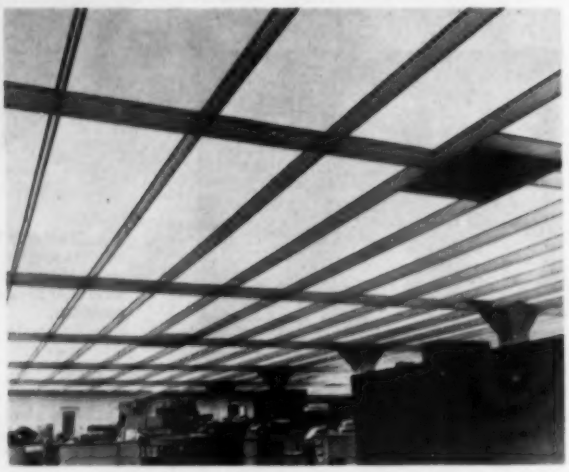
Predicting Fuel Stability

Measuring the scattering of light by gum particles in petroleum fuels promises to become an effective method of predicting behavior of fuels in extended storage, according to a Naval Research Laboratory report. The problem of instability and incompatibility of petroleum fuels is one of increasing concern to industry, as well as to the Navy. There is no universally accepted test procedure, however, for predicting instability of fuels from various sources and under varying conditions of storage.

Gradual formation of insoluble gum is the element of fuel instability considered most undesirable. Research has demonstrated that marked changes can be observed in presumably unstable fuels by the light scattering method when these fuels are aged for only a few days. Data obtained on the effect of two stability additives show that, on aging, fuels containing these additives develop markedly less light scattering than fuels without the additives. The light scattering method thus promises to be useful in evaluating stability additives.

Lighting Converts Factory to Office

Luminous ceilings have been drafted for the conversion of factory assembly area into modern office area. The Aurora Pump Division, New York Air Brake Company, solved three complex problems when it installed the luminous ceilings: it provided a smooth surface to mask the old irregular saw-tooth roof; it concealed many unsightly air ducts, a sprinkler system, and miscellaneous pipes; and, most important, the employees working in the new office area are provided with evenly distributed light. Final installation covered 10,000 square feet with a ceiling approximately nine feet high. Louvers were hung to substantially reduce noise from office machines. The translucent plastic sheeting used in this luminous ceiling falls down when the room temperature reaches 140 F. The sprinkler system releases water at 165 F, so there is no interference.

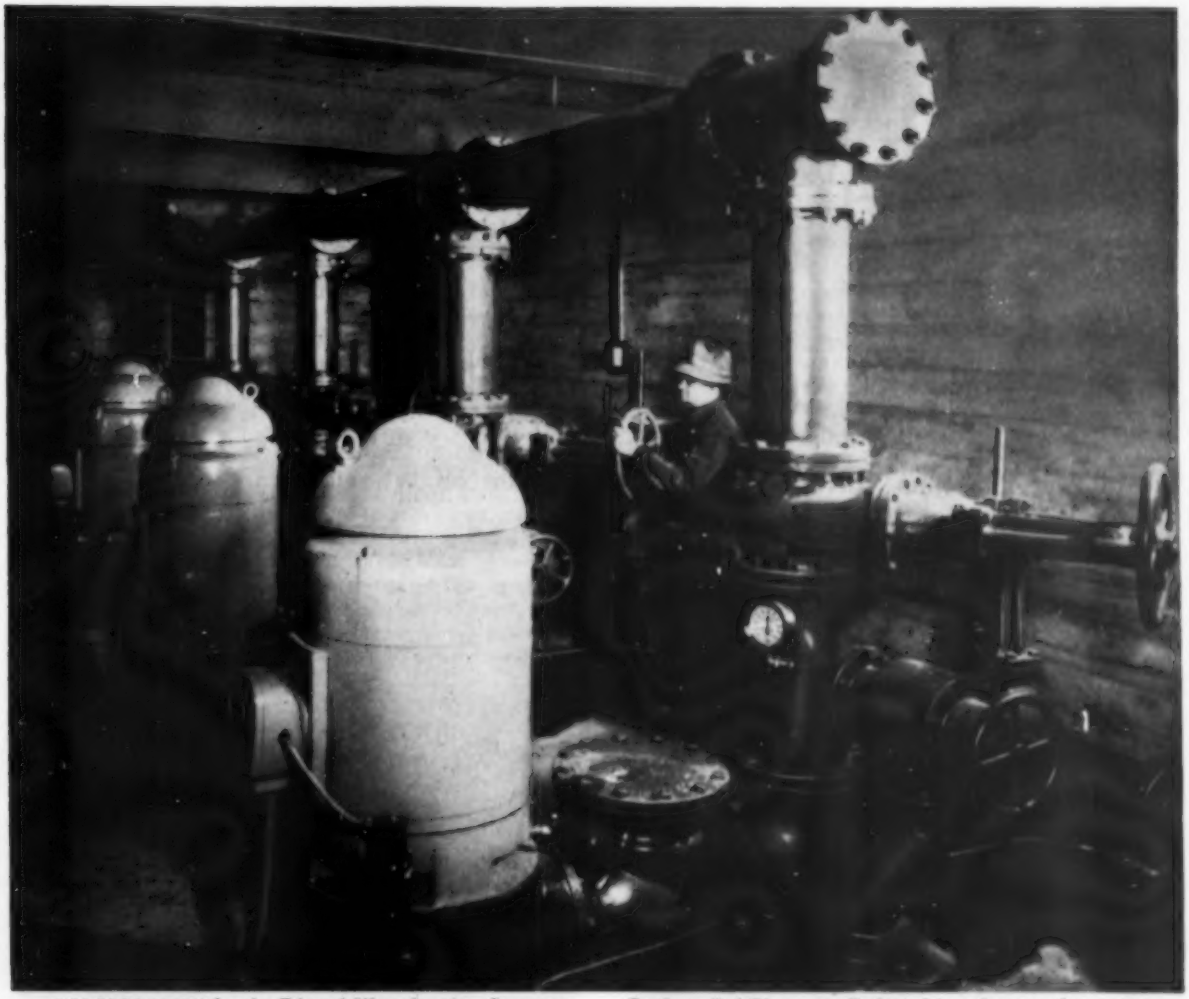


Innovation in Power Practice

Dayton Power & Light has ordered the first "once-through" type of drumless boiler to operate at a steam pressure in the subcritical range. Though such units have been installed previously in Europe, this is the first destined for the United States. It will be the largest of this type any where in the world.

The boiler is a Sulzer Brothers, Ltd., unit, sold through Combustion Engineering. The Dayton steam generator will serve a 125,000 kw-turbine-generator. It will supply steam at 1800 psig with primary steam temperature of 1,000 F, and reheat temperature of 1,000 F.

(more ideas in action on page 26)



FIRE PROTECTION for the Edward Hines Lumber Company is assured by four Worthington vertical turbine fire pumps. Costly well drilling was eliminated here because the versatile Worthington pumps take water from a nearby river.

We hope these Worthington pumps are never used!

Don't get us wrong. They're good pumps. Can't be beat for always-adequate pressure, long life and real dependability.

Thing is, though, they're fire pumps — Worthington vertical turbine fire pumps — ready to supply water for the sprinkler system at the Edward Hines Lumber Company in Westfir, Oregon.

Main point — if and when they're ever needed, these Worthington pumps will go to work instantaneously, delivering enough water to quench any fire. Reason is they're always primed. And on top of approval by Factory Mutual and Underwriters Laboratories, they're guaranteed by Worthington to deliver rated capacity — whether pumping from a deep well or from a surface supply.

Our bulletin W-450-B42 tells all about the Worthington vertical turbine fire pump. Write for it today — you may be glad you did. Worthington Corporation, Vertical Turbine Pump Division, Harrison, N.J. D.S.I

WORTHINGTON

THE WORLD'S BROADEST LINE ASSURES YOU THE RIGHT PUMP FOR EVERY JOB

CENTRIFUGAL • ROTARY • STEAM • POWER • VERTICAL TURBINE

CONSERVE GROUND WATER — IT IS A VALUABLE RESOURCE

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ideas in action

. . . starts on page 24

Philadelphia Electric put in an order for one of these C-E, Sulzer Monotube Steam Generators last year, but this Philadelphia unit is designed for super-critical pressure of 6,000 psig — the highest steam pressure adopted to date any where in the world.

Metallizing Reclaims Valves

Standard Oil of California found that they could save thousands of dollars every year by using metallizing techniques in the repair of valves. Standard's reclamation department handles up to 5,000 valves yearly. Most of them require reconditioning of some kind. The valves handle water, sand, oil, gasoline, grease, chemi-

cals,—the net result being terrific wear from abrasion and corrosion. Standard found that a ten-inch plug could be metallized with stainless steel in two hours, whereas a welder would have required two days to do the same job. Little excess metal need be applied in metallizing, appreciably reducing grinding time.

Make High-Pressure Connections

The National Bureau of Standards has devised a special insulating seal for effectively solving the problem of leakage around electrical connections to high-pressure vessels. The seal utilizes a sapphire bushing to obtain the correct combination of high mechanical strength and good electrical insulating properties. The simple, inexpensive device has successfully withstood pressures up to 170,000 psi. The seal operates in two stages. An O-ring provides the initial low-pressure seal through compression contact between the seal's electrode and the interior wall of the cavity in which the assembly is installed. This seal lasts up to about 30,000 psi. At higher pressures, the O-ring becomes ineffective. A tapered section of the electrode then deforms against the bushing to seal off leakage between the bushing and the electrode. Next, a soft steel pad, integral with the seal, is deformed to seal off the leakage between the bushing and the wall of the cavity.

Steam on Wheels

After two years of operation in Chicago, a good idea is spreading to St. Louis and beyond. Mobile steam service is made available on an emergency basis by installing a 100-hp steam generator (Clayton) on a truck so that steam can be made and delivered within a few hours after a boiler breaks down. Feedwater intake and steam delivery connections are located outside the truck

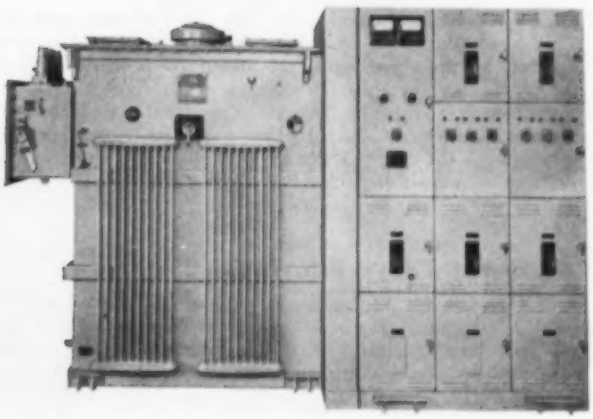
body, similar to a fire engine. Water hose and electrical cable are on reels inside the body. A water softener and a 550-gallon fuel supply complete the installation. Among the performances already chalked up by the Chicago unit are keeping a university building from closing its doors for two weeks, rescuing a mushroom crop, and maintaining manufacturing processes in a chemical plant.

Pioneer High Frequency Lighting

Forerunner of many large industrial, commercial, and institutional lighting installations has been completed at Union College's Alumni Memorial Field House. The system is the first application of high-frequency fluorescent lamp operation for the general lighting of a large area. General Electric made the installation, comprising 490 eight-foot-long fluorescent lamps fed by 400-cps power. Chief benefit of the high-frequency idea is that it is one of the most economical methods yet devised for obtaining high levels of light in high-bay areas. It costs 15 percent less to install than an incandescent-mercury

SORGEL Substations are the best for Industrial, Commerical and Institutional Applications

SORGEL transformers are particularly adaptable for indoor installations; in hospitals, libraries, schools, institutions, office buildings, and other structures where low noise levels are an important factor.



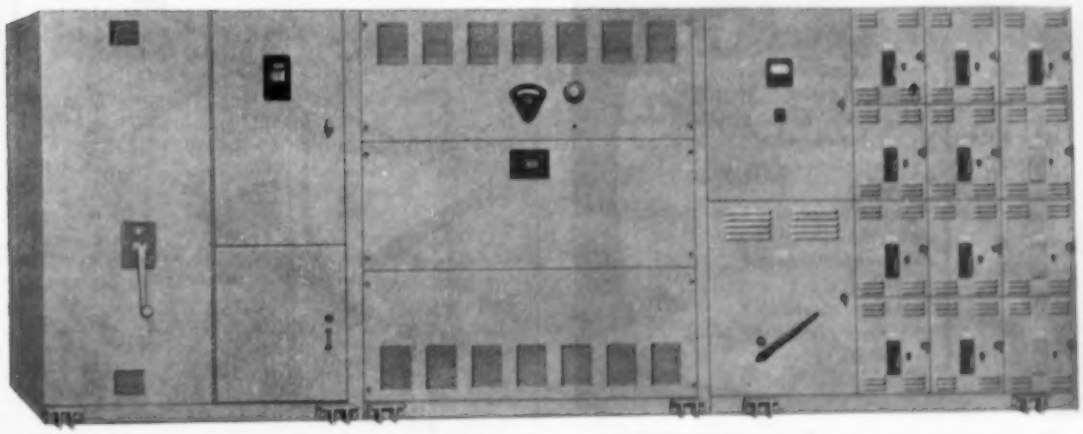
500 Kva, 13,800 volt Askarel-cooled SORGEL transformer, with primary liquid filled switch, secondary meters, and circuit breakers.

Because substations depend so much on transformers for continued, uninterrupted long service, SORGEL transformers are especially designed and constructed to meet the exact requirements of substation applications.

SORGEL transformers are not just ordinary transformers. They are especially designed and constructed to be installed indoors, close to load centers, thereby obtaining the most efficient distribution and better voltage regulation.

Without additional cost we make the substation fit the job, instead of expecting you to try to make the job fit the substation.

SORGEL transformers, 100 to 3000 Kva, all voltages up to 15 Kv, either dry-type or Askarel-cooled, to meet any requirements, can be furnished with any make or type of switchgear. And they are also procurable from any substation manufacturer.



2000 Kva 3-phase, 13,200 volts air-cooled dry-type transformer, with primary switchgear, metering, and secondary breakers.

Sales Engineers in Principal Cities

SORGEL ELECTRIC CO., 841 West National Ave., Milwaukee 4, Wisconsin

40 years experience in the development, manufacturing and application of transformers

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FREE 112-page handbook of

TUBE CLEANING equipment

NEW WILSON CATALOG GIVES DATA ON:

- *air-driven cleaners*
- *drill type cleaners*
- *electrically-driven cleaners*
- *water-driven cleaners*
- *cutter heads*
- *air-driven motors*
- *electric motors*
- *steam-driven motors*
- *water-driven motors*
- *and many accessories*

FOR CLEANING THIS EQUIPMENT:

- *boilers*
- *gas coolers*
- *sulfite evaporators*
- *glycerine evaporators*
- *fuel oil heaters*
- *polymerization units*
- *miscellaneous evaporators*
- *humidifier tubes*
- *water heaters*
- *crude column heaters*
- *small transfer lines*
- *miscellaneous heaters*
- *miscellaneous condensers*

FOR THESE INDUSTRIES:

- *air conditioning*
- *refrigeration*
- *oil refineries*
- *synthetic fibers*
- *electro-chemical*
- *synthetic rubber*
- *paper*
- *food process*
- *steel*
- *manufactured gas*
- *chemical*
- *pharmaceutical*
- *power generating plants*
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Representatives in principal cities

THOMAS C. WILSON, INC., 21-11 44th Ave., Long Island City 1, N.Y.

Cable address: "Tubecleon," New York

WILSON TW 054

TUBE CLEANERS • TUBE EXPANDERS

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ideas in action

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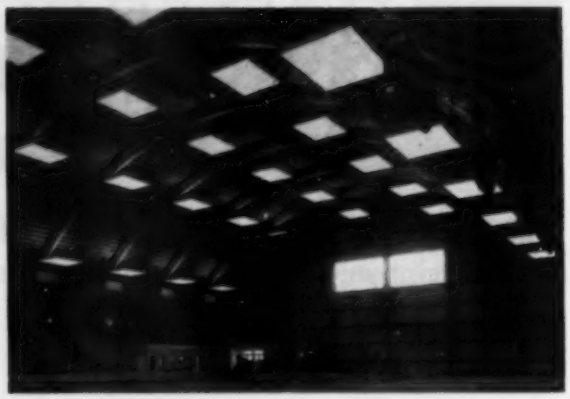
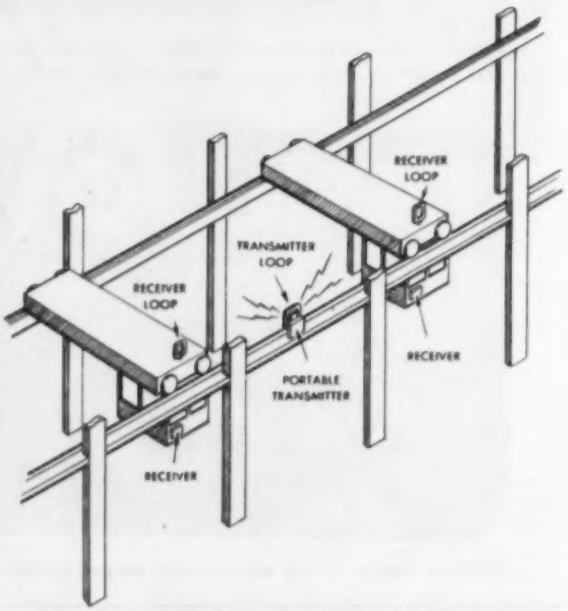


system originally considered, and offers an estimated 50 percent savings in annual operation and maintenance costs—at the same time producing 20 percent higher levels of comfortable light. Fixtures are lighter. Power is derived from rotary frequency converters that change 60 cps to 400 cps. Fixtures are mounted from 60 to 34 feet from the floor. Each lamp produces 6,000 lumens. The maintained light level is 45 footcandles.

Control Those Runways

A system for automatically monitoring the approach of an oncoming overhead crane has been developed by Femco, Inc. Warning or shut-off action can be made effective at separation distances from one to 20 feet. The



equipment consists of receivers and a transmitter tuned to the same frequency. At the predetermined proximity, sufficient energy is transferred to a receiver to actuate an alarm or shut-off.

(more ideas in action on page 30.)

Hudson saves $480,000 a year burning coal the modern way

A decision to improve its power service opened many possible courses of action to Hudson Motor Division of American Motors Corp. Based on findings of consultants Boddy, Benjamin and Woodhouse, Inc., Hudson decided to modernize completely its coal-burning, steam, electrical and compressed air equipment.

Today, steam at Hudson is supplied by three new boilers instead of ten old ones. Other new equipment includes a coal-handling system, automatic combustion controls and automatic ash disposal system. Manpower needs in the boiler area have been cut from 14 to 10 and in the compressor area from 8 to 6. With a reliable power supply, Hudson is protected from service interruptions. And the reduced cost of operation resulting from the new equipment will pay off the original investment in six years, leaving an annual saving of $480,000 thereafter!

Investigate Your Fuel Costs

If you're planning to modernize your plant or build a new one—or if you are just interested in cutting fuel costs—find out how coal, burned the modern way, compares to other fuels. Why not talk to a consulting engineer or your nearest coal distributor. Their advice may save you thousands of dollars each year.

facts you should know about coal

Up-to-date coal burning equipment can give you 10% to 40% more steam per dollar.

Automatic coal and ash handling systems can result in a virtually labor-free plant.

Coal is the safest fuel to store and use. No dust or smoke problems when coal is burned with modern equipment.

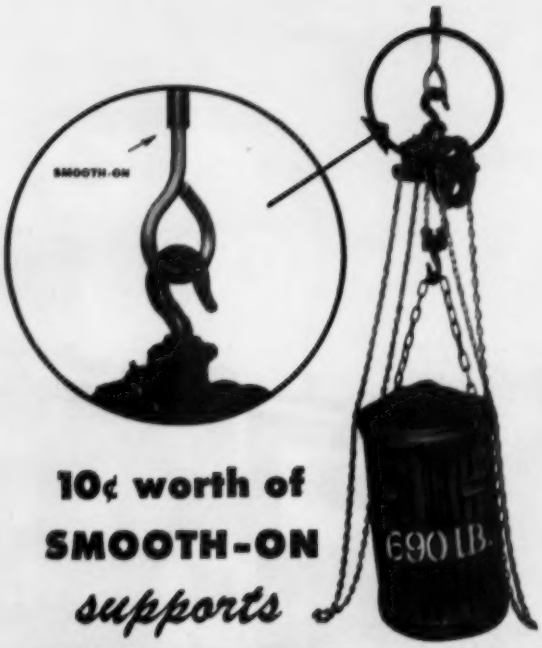
In most industrial areas, bituminous coal is the lowest-cost fuel available.

Between America's vast coal reserves and mechanized coal production methods, you can count on coal being plentiful and its price remaining stable.

For further information or additional case histories showing how other plants have saved money burning coal, write to the address below.

NATIONAL COAL ASSOCIATION
Southern Building, Washington 5, D.C.

Circle 519 on reply card for more data



10¢ worth of SMOOTH-ON *supports* 690 POUNDS!

Smooth-On, with its expanding action and iron-hard set, made the joint which supports the load shown —an ash can loaded with iron filings to a total weight of 690 pounds. Only Smooth-On No. 1 is holding that eyebolt in that pipe!

Hundreds of Uses This principle can be used in dozens of ways around both plant and home. By expanding hard and tight within a repair, Smooth-On IRON Cement stops leaks, fills holes and seams in any metal, patches boilers, repairs water jackets and radiators, corrects wobbly bolts and screws, plugs tanks, holds loose parts tight — in fact, does all kinds of things where that combination of strength and expansion can be used. Smooth-On IRON Cement never tires, or softens from age. Years after a repair is made the Smooth-On will be found harder, tighter, stronger.

Keep Smooth-On No. 1 on hand for that emergency repair. It does not deteriorate. Whenever you need it, just mix and fix. It sets in half an hour, hardens to Rockwell R-70 in 24 hours. And of course there is Smooth-On No. 2, a slower-setting IRON Cement but with the same dependable properties.

SO402

FREE Repair Handbook

New, completely revised 48-page illustrated handbook, shows in detail how to make all the repairs referred to here plus dozens of others. Get a copy from your supply house or write us. Sent postpaid.

SMOOTH-ON MANUFACTURING CO.
Dept. 19, 572 Communipaw Avenue, Jersey City 4, N. J.

SMOOTH-ON
THE IRON CEMENT OF MANY USES

Circle 520 on reply card for more data

ideas in action

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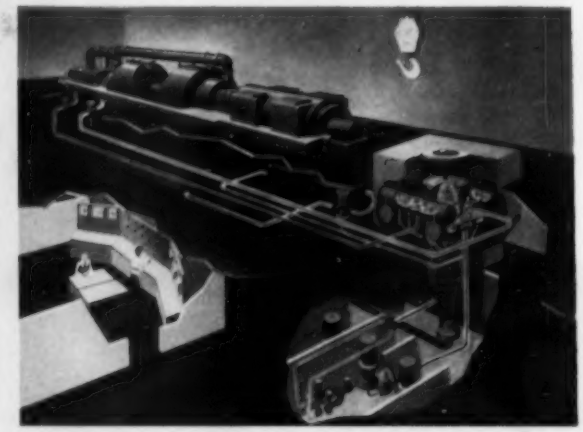
Atom Boiler for Industry

Plans for a 180,000-kw dual-cycle boiling reactor have been unveiled. The accompanying illustration shows how this atomic boiler might look when coupled to a turbine generator for production of power. The reactor is described as "a major advance toward the economic generation of electricity from atomic energy." The makers, General Electric, point out that water is boiled directly inside the reactor (right) to produce

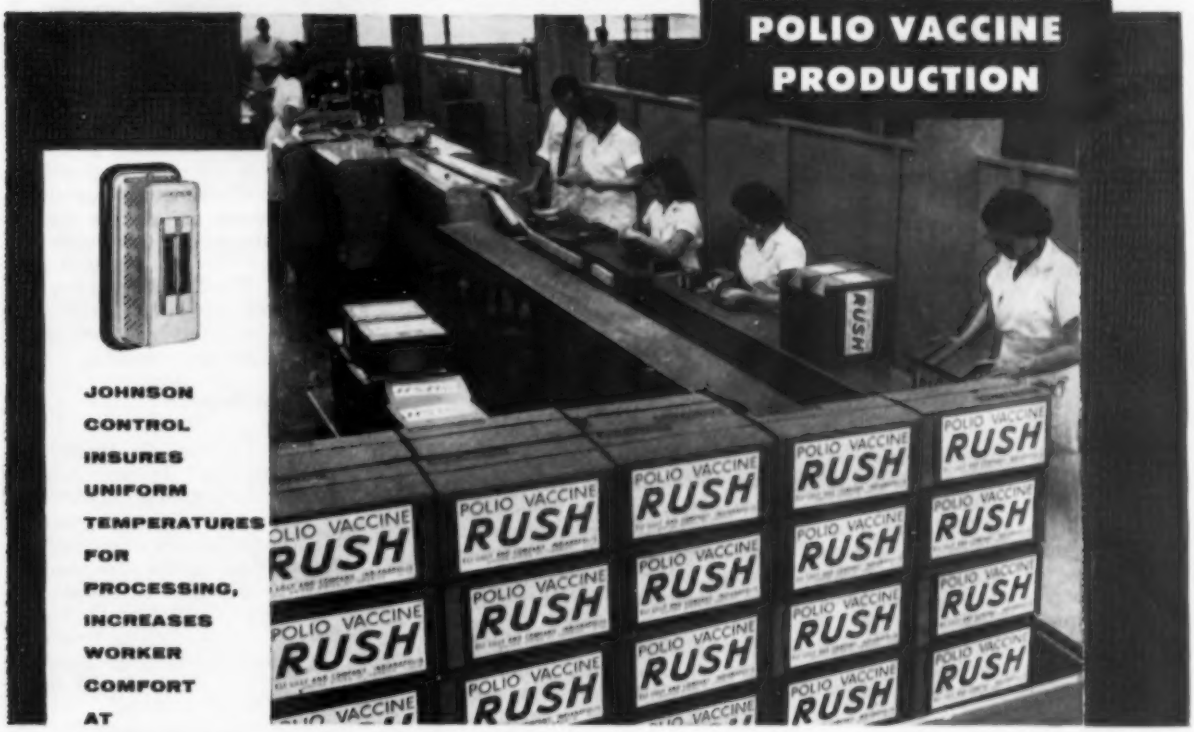


steam that drives the turbine generator (left)—with no intervening heat exchangers to isolate reactor steam from turbine blading. This new reactor will be used in the proposed full-scale nuclear electric generating station to be built near Chicago.

Fire Venting Tested

Recent tests proved that automatic heat vents greatly reduce fire damage. Pyrodome and Pyrovent units, manufactured by Wasco Products, were tested. When excessive heat develops, they automatically open so that heat, smoke, and gases escape. Combustion products do not rise to the ceiling, mushroom, and spread horizontally. Fire fighters can see the blaze. Risks of asphyxiation are greatly reduced. Temperatures do not build up.

MADE-TO-ORDER-TEMPERATURES PLAY KEY ROLE IN POLIO VACCINE PRODUCTION



JOHNSON CONTROL INSURES UNIFORM TEMPERATURES FOR PROCESSING, INCREASES WORKER COMFORT AT ELI LILLY AND COMPANY

A dramatic race against time highlighted the mass production program for Salk anti-polio vaccine. At Eli Lilly and Company in Indianapolis—a major producer of the vaccine—medical scientists, production experts and engineering specialists worked with remarkable speed to perfect processing techniques and provide the necessary production facilities.

A variety of heating, cooling, ventilating and humidity control problems were involved. Controlled spaces include incubation and test rooms, sterile processing areas, filling, labeling and packaging rooms, animal quarters and animal test rooms.

As the special requirements of each of these areas were determined and the engineering work planned, Johnson engineers concurrently planned the control systems and readied them for installation. In some areas, the flexibility of existing Johnson Control installations made it possible to satisfy the new needs with only a few simple rearrangements or adjustments.

The critical nature of polio vaccine production puts a premium on both accuracy and dependability of control. On the basis of past experience with Johnson Control, extending over a period of more than 40 years, Eli Lilly and Company entrusted many of these important control installations to Johnson. All work was completed within the alloted time limits, and the apparatus is functioning at the desired efficiencies.

Johnson Control combines the adaptability, accuracy and economy to solve correctly any problem of heating, cooling, ventilating, air conditioning or process control. Whether your problem involves comfort control or the provision of protective temperatures and humidities for products and processes, talk it over with a nearby Johnson engineer. His advice is yours without obligation. JOHNSON SERVICE COMPANY, Milwaukee 2, Wisconsin. Direct Branch Offices in Principal Cities.

Three types of live polio virus are grown in this incubation room. Johnson Thermostats, regulating Johnson Valves on steam and chilled water coils of the fan unit, maintain a uniform temperature of 96°F. Accuracy is within ± ½°F. under normal operating conditions.

In another incubation room, which is also maintained at 96°F., test tubes revolve on drums in safety and potency tests. In labeling and packaging rooms (shown at top of page), workers enjoy ideal temperature and humidity conditions for comfort.

JOHNSON CONTROL

TEMPERATURE ↕ AIR CONDITIONING

PLANNING • MANUFACTURING • INSTALLING • SINCE 1885

Circle 521 on reply card for more data

our readers write

. . . to industry & power

Requests for Refresher

Gentlemen:

I would appreciate having my name placed on your mailing list for the "Thermodynamic Refresher" articles.

A. H. Buck
Works Engineer
Continental Foundry & Machine Co.

Gentlemen:

"A Thermodynamics Refresher—I, The Basic Concepts and Definitions" by John F. Lee in the May issue of INDUSTRY & POWER has been read with much interest. We note that copies are available and we would greatly appreciate your having two copies sent to us.

Also, if you intend making copies of the succeeding articles available to your readers, we would appreciate your sending us two copies of each article when released.

W. A. Shanks for
C. E. Evanson, President
T. A. B. Engineers

• *All reader requests, such as these above, for copies of "Thermodynamics Refresher" are being filled as rapidly as possible. Demand for these reprints has developed to be quite heavy.*

More About Paint

Gentlemen:

I read with great interest your article entitled "Specifying Paint Protection," appearing on page 47 of the February issue of INDUSTRY & POWER, and particularly applaud the emphasis which you placed upon adequate surface preparation.

There were several conclusions of yours that are not in accord with our observations, and I would like to inquire what your experience has been that resulted in your formulating these conclusions.

The first statement that surprises me is your recommendation that wash primers be brush applied as the brush insures a wet coat and a washing action to free fine dust from the metal surface. Our experience has been that the surface of any metal is thoroughly wetted when sprayed, assuming that correct spray techniques are observed and the gun is not held too far from the surface of the object being coated. Further, we have observed that the jet of air that is integral to spray applications removes the fine dust to which you refer. I can think of no better example of both the adequacy of prime coat applications by spray gun, and the removal of any surface contaminants of the nature of fine dust than the perfect protective films which are applied to automobiles.

For surfaces which do not require quite the same high quality appearance but which are subject to the same or even more rigorous exposure as the industrial structures concerning which you wrote, I invite your attention to the durable spray-applied finishes found on railroad diesel engines, coaches, and also ships. In this latter connection, I invite your attention to the fact that the Navy has spray painted its ships for many years, and I am not familiar with any findings by the Bureau of Ships that such coatings were inferior to those which were brush applied.

On page 49, you recommend that the prime coat be brushed, yet all of our experience has shown that adhesion is equal whether the material be brushed or sprayed, provided there is adequate wetting of the surface because it is the mechanical bonding of the molecules which results in a protective film with good qualities of adhesion.

I have just had an opportunity to review the work of two of the principal industrial and bridge painting contractors in different parts of the United States. They have both expressed a preference for spray applications over brush painting because they get more uniform, fuller coats which are desirable because brushed surfaces break down more readily in that they are not as dense. Due to the serration of brush marks, there are frequently areas where the protective film has a minimal thickness, and of course, here is where breakdown first occurs. I believe if you will examine the illustration in the lower, right-hand corner of page 49, you will note that the surface appears to be brushed and failure occurred in the serrations in the film due to the irregular thickness thereof as a result of the irregular pressure of the brush.

As I am seeking information, I shall be deeply indebted to you for anything which you can supply me concerning the subjects discussed above.

Before concluding, I would also like to inquire concerning your experience with hot spray applications in this type of maintenance painting.

Please accept my sincere thanks for your attention to this inquiry.

Frank R. Pitt
The DeVilbiss Company

• *Mr. Pitt's letter has been forwarded to our author, Mr. Warren D. Palmer, for his comment.*

Article For Report

Gentlemen:

We find the article "In-Plant Distribution System" in the August 1954 issue of INDUSTRY & POWER to be very interesting in connection with a report we are compiling.

We would appreciate your sending two additional copies of this article.

Willard G. Axtell
Chief Engineer
Samsonite Luggage Division
Shwayder Brothers

• *Always happy to oblige.*

next month in
INDUSTRY & POWER . . .

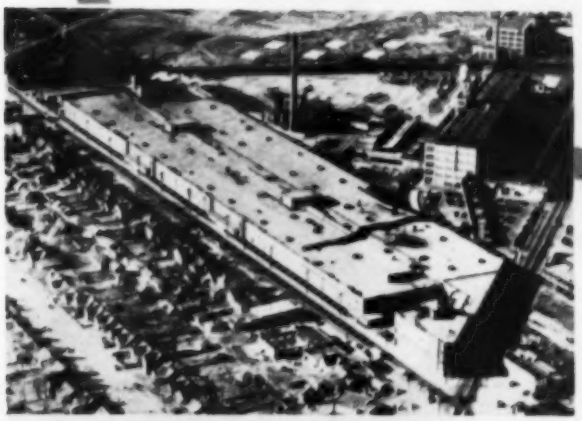
The powerhouse that couldn't grow--but did!

What can you do when your plant area is so built up that expanding the powerhouse (physically, that is) is simply impossible? Allis-Chalmers had this problem with its powerhouse in West Allis, a powerhouse that had given dependable service for more than 50 years. They had but one alternative: pack more power into the existing space. How?

watch for the July issue of INDUSTRY & POWER

7 DETROIT STOKERS

in two *Eli Lilly and Company plants*

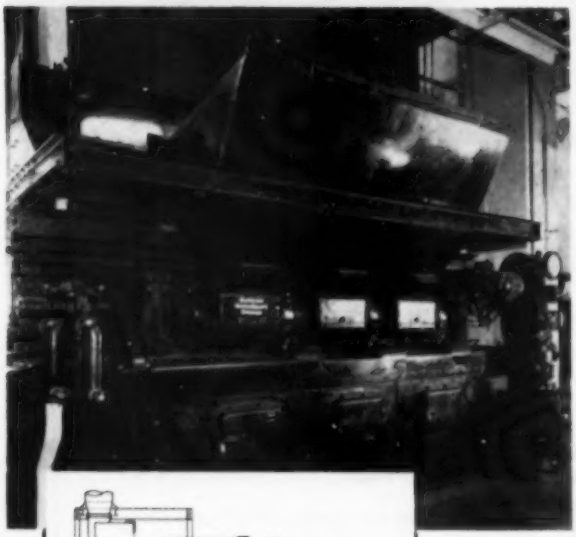


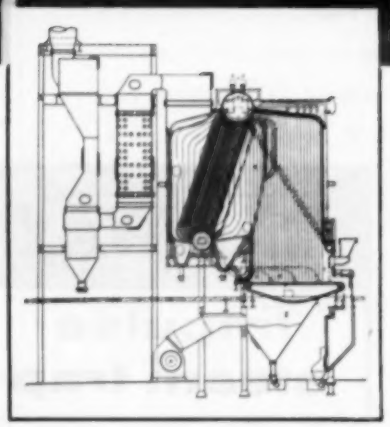
FOUR CONTRACTS

High efficiency with low maintenance—ability to handle rapidly fluctuating loads, and cleanliness are Detroit Stoker features that appealed to Eli Lilly and Company engineers.

Cleanliness—elimination of sources of possible contamination—is of paramount importance to plants making thousands of medicinal products having the highest reputation for purity.

At the left one of the two Detroit RotoGrate Stokers at the Lilly Indianapolis plant. Capacity each Babcock and Wilcox unit 75,000 pounds per hour. RotoGrates also are in service at their new Tippecanoe Laboratories, Lafayette, Indiana.





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DETROIT *SINCE 1898* **STOKERS**

DETROIT STOKER COMPANY

GENERAL MOTORS BLDG., DETROIT 2, MICH.

District offices in Principal Cities • Works in Monroe, Mich.

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what are good little Yarway Impulse Steam Traps made of?

STAINLESS STEEL, *of course*

Body and all internal parts of YARWAY Impulse Steam Traps are of *stainless steel*—one of the biggest steps taken by any trap manufacturer to increase trap life and reduce maintenance.

Other YARWAY Impulse Steam Trap features:

- **Gets equipment hot in a hurry—and keeps it hot.**
- **Good for all pressures without change of valve or seat.**
- **Easy installation—small size, light weight.**
- **Non-freezing at low temperatures.**
- **Six standard sizes, ½" to 2".**

Want *proof* of performance? Try a YARWAY Impulse Trap and Fine Screen Strainer FREE for 90 days in your own plant. For free trial or free Trap Selector, write . . .

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OVER 1,000,000 YARWAY IMPULSE TRAPS SOLD—STOCKED BY 270 CONVENIENT INDUSTRIAL DISTRIBUTORS

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impulse
steam trap

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Back-pressure valve keeps hot distilled water under 20-psi pressure. Tanks assure assayed supply at all times.

I&P EXCLUSIVE

How they did it at Eli Lilly ...

Power Services For Salk Vaccine

H. A. BERGEN, Editor

We gratefully acknowledge the part that the following Eli Lilly engineers played in making this story possible: J. C. Siegesmund, vice president of engineering function; William H. Cummings, department head, chemical equipment engineering; Roy H. Whaley, manager, electrical engineering department; Robert E. Jenkins, project engineer; and Joseph P. Gibbons, project engineer.

POWER SERVICES DELIVERED on short notice made it possible for Eli Lilly and Company to convert one of its buildings in Indianapolis to the production of Salk Polio Vaccine quickly. In just 90 days from the go-ahead, Building No. 50 was made ready for production of the new product. How was this done? By taking advantage of previously existing power services —services that had been well engineered when they were first put into the building.

Eli Lilly's engineers have long planned their installations so that major production changes are never delayed because power services are not available. And when the power demands for Salk Vaccine production were made, they were ready.

Several standard practices at Eli

Busway runs up through all five floors of building, supplying power and lighting loads. Service flexibility is main concern.

This is one of the two fans that combine to pull some 30,600 cfm (over one ton per minute) of air through animal rooms.

Lilly illustrate how they assure that the power services are always ready to accommodate a production change:

¶ They bring enough power services capacity into each plant area to support the character of the company's production, even if this means temporarily oversizing for the production's needs immediately at hand.

¶ They run all piping, electrical work, ventilating duct, and similar power services "conveyors" in exposed rather than concealed locations. Changes on exposed runs are accomplished much more economically and quickly than on concealed runs.

¶ They run their principal electrical feeders via busway to assure maximum flexibility.

¶ They design all piping and conduit racks to carry at least 25 percent more than will be required when first installed. In this way, changes in runs and additional runs can be made quickly, using the spare room.

¶ They feed only one motor through any conduit run from the control center to avoid crowding and to insure greatest flexibility.

¶ They provide spare cubicles in all motor control centers to accommodate future changes and additional capacity. They keep spare controls right in control centers where they may be required. They keep the number of different kinds of controls to an absolute minimum so that minimum inventories need be kept, and so that the nearest spare is most likely to be the right spare.

¶ They have established ¾-inch conduit as the smallest size to be used. Additional motor control wiring or heavier motor leads for bigger motors then can be pulled through existing conduit, again saving time and money.

Power in ¼ Time

By rigidly adhering to such practices as these, Eli Lilly's engineers estimate that they were able to provide power services for Salk Vaccine production in just ¼ of the time that it might otherwise have taken. Serving a plant manufacturing products that are under constant research, Eli Lilly's power services engineers have learned that a major change can be expected in every plant production area within any 12-month interval. And when a new product is put into production, there is an even greater tendeny for major changes as better ways of production are developed to improve the initial methods. They will tell you, "In our business, it pays to oversize power services when you first go into any plant area simply because you can bank on increased power requirements within one year."

When an urgent demand for power services arise, the engineers can reduce most of their problems to reconnection and extension of the basic services, which are already on hand in sufficient capacity. They can then turn to those special problems that cannot be anticipated very well. And Salk Vaccine production had its share of both kinds of power services problems.

Reconnection and Extension

The first category of problems — reconnection and extension — were concerned primarily with steam, electrical, air conditioning, and distilled water services. Steam is brought in to the Salk Vaccine building through underground lines from another building of the Eli Lilly plant. Steam is purchased from Indianapolis Power and Light Company at 250 psi. It is delivered un-

derground through a 10-inch line and a 12-inch line. These incoming lines are joined at a common header which feeds two turbine-generators acting as throttle valves. One turbine-generator—a 2000-kw General Electric unit — bleeds steam at 100 psi and exhausts steam at 7 psi. The other is a 500-kw General Electric turbine-generator that exhausts 100-psi steam. The 100-psi steam is routed through the plant for process heating. The 7-psi steam is routed around the plant for space heating.

The problem in the Salk Vaccine production building was merely to take the incoming steam and reroute it to the new utilization locations. Adequate incoming capacity had been provided by prior planning some years ago.

Because large holes could not be cut in building floors, major duct had to run outside. Open, ribbed duct on left carries ventilating air. Insulated duct on right is for air conditioning.

Heart of Flexibility

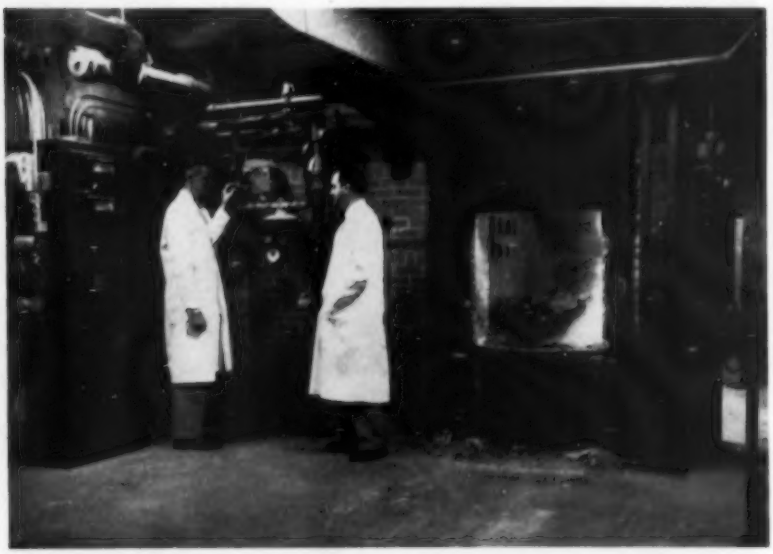
The heart of the flexibility in the electrical system is a busway installation that runs from the basement up through a chase to the top floor of the building. Thus, 480-volt power is available on a plug-in basis. A separate busway runs up the same chase to supply lighting and low-voltage secondary power. Ample working room is available in the chase on each floor so that busway tapoffs can be easily handled. In accordance with good practice for pharmaceuticals manufacture, all tapoffs leave the busway in conduit.

Electric service comes to the Salk Vaccine building at 4160 volts over a set of dual, underground, radial lines. Reliability is assured with manual circuit breaker throwover by which either of the incoming 4160-volt feeders can be used. The system is grounded wye.

Study Transformer Economics

When the substation for the building was first designed, the engineers found that economy and extra capacity could be achieved at the same time. The load forecast for the building was in the neighborhood of 425 kva. The next available transformer size was 500 kva. To provide additional future capacity by the addition of fans was found to total the cost of 750-kva transformer without fans. Furthermore, the fans on a 500-kva unit would boost its capacity to only 625 kva. Therefore, it was decided then to install a 750-kva transformer without fans. When Salk Vaccine production was assigned to the building, the additonal electrical capacity needed was already there.

The standard practice for supplying motors at Eli Lilly is to use busway-fed motor control centers, feeding the motors through individual conduit. A minimum variety of standard control center components assures adaptability, flexibility, and reduced inventory. The entire five-story building was made ready for new motor loads by re-using all existing motor control centers in their previously installed locations with but one exception. One motor control center had to be moved from what was a chill room to a janitor's closet out in a hallway. Because the motor control centers all had been assembled on a vertical-rack basis, no trouble was met in getting a six-rack motor control center into the closet.



Special incinerator was built to dispose of production wastes. Automatic combustion controls assure safety and complete combustion. No objectionable discharge odors have been reported.

Meet Critical Requirements

Perhaps the most critical problem in the extension of power services came up in the air conditioning of the rocker room — the room where the polio viruses are grown in jars

on rocking tables. A new Carrier unit was installed in this room to maintain a temperature of 96 F throughout the year. Cooling is obtained from a chilled water system. Steam coils provide heat.

Guard Against Overtemperature

The principal problem in the rocker room is to guard against overtemperature because the viruses would be killed if they became too warm. (The only adverse effect of undertemperature would be the loss of time due to reduced growth rate of viruses at lower temperatures—a much less serious effect.) Accordingly, controls were devised to immediately warn of any overtemperature, with but secondary importance given to the possibility of undertemperature.

Three independent systems control the rocker room temperature. One controls the heating and cooling action of the air conditioning equipment. Another is a recording system that keeps track of the rocker room temperature at eight different locations. The third system sounds an alarm any time that overtemperature exists.

Sensing unit for control of the air conditioning unit is a Johnson Service pneumatic thermostat mounted in the center of the rocker room about five feet from the floor. Heating and cooling action is initiated in response to the calls made by this sensing unit.

Detect Stratification

The recording system receives temperature information from seven Minneapolis-Honeywell units spotted around the rocker room. The units are located either two feet or seven feet from the floor, in checkerboard fashion, so that any tendencies toward temperature stratification or hot spotting are recorded. (The "rockers" are large platforms, 30 inches by 40 inches, that rock back and forth to agitate the virus solutions. The agitation of these platforms induces air circulation that helps break up temperature stratification. The recording system is maintained for process control records nevertheless.)

The alarm system senses through six Fenwal Thermoswitches spotted around the rocker room near the ceiling, where overtemperature is most likely to develop first. The Thermoswitches are set for 96 F, plus or minus one degree. In case of overtemperature, a Thermoswitch sets off an alarm and a pilot light indicates which Thermoswitch

Temperature is very critical in room where virus is grown. Three independent control systems are used. Sensing units comprise Fenwal Thermoswitches (above), Johnson Service unit (right, above), and Minneapolis-Honeywell units (right). Overtemperature gives alarm to prevent killing polio viruses.

Inherent flexibility of motor control centers had been enhanced by standardizing on a few fundamental and versatile components.

Layers of cork were placed over windows on outside west wall to stabilize the temperature effects due to outside weather.

went off. The alarm bell can be silenced for as long as one hour. If satisfactory temperature has not been reached in that time, the alarm will sound again.

The west wall of the rocker room is an outside wall with tall, glass block windows. To help stabilize the erratic effects of weather, a four-inch lining of cork was placed over the glass block windows. The south wall comprises six inches of concrete. The east wall of the rocker room is not exposed.

The distilled water system already in the building was made to serve the needs of Salk Vaccine production. The stills are used as is. Some modification of the circulation system took place. This essentially consisted of installing a back pressure valve to keep a pressure of 20 psi on the system. This pressure, combined with water temperature maintained at 160 F, insures adequate circulation of hot distilled water so that the system remains quite clean.

Three holdup tanks are used. One tank holds distilled water currently being drawn off for use. Another holds water being assayed. The third tank is being filled.

One of the most pressing problems involved a new, special facility—ventilating the rooms where animals used in the vaccine production process are kept. Two American Blower fans were installed to make a complete air change every three minutes, without recirculation. They pull a total of 30,600 cfm, or more than one ton of air per minute. The air entering the animal room is heated by steam coils when necessary to maintain 80 F minimum.

Special duct was built so that air from the animal rooms, on the second floor, could be brought to the top of the building for discharge to the atmosphere. The added height assures maximum diffusion.

Another special, unique problem is one of waste disposal. A special gas-fired incinerator was built, with automatic combustion and flame control. An old chimney in the building—out of service for 20 years—was relined with fire brick to carry off the incinerator gases. The incinerator is operating quite effectively. No disturbing odors have been reported.

This, then, is how power services were made available on short notice. These power services are feeding an investment of hundreds of thousands of dollars, all of which was expended in just 90 days. Behind the entire project is a theme being heard throughout industry more often from day to day: plan in advance for adaptability and flexibility.

I & P Quotations . . .

Industry Continues March From Cities

THE TREND of industrial development away from large metropolitan centers, especially in heavy industries, has been marked for several years. This is particularly true in the case of the chemical industry. In looking over a recent list of some 480 construction projects in the chemical industry, I found only nine in or near a major metropolitan center — less than two percent. . . .

As pure speculation on my part, I do not foresee the establishment of new metropolitan centers as we now know them, but rather, substantial growth of a great many smaller communities and in many cases the creation of new urban centers where formerly there were only small country villages or no organized community at all. This sort of modern pioneering is going on now in many locations and the adaptability with which Americans are forming new communities must provide fascinating study material for sociologists.

William C. Foster, President Manufacturing Chemists' Association

Fig. 1 — Water treatment installation at a Southern textile mill. Filter house is behind floc-former units (left) and settling basin.

How Can You Ignore

Industrial Water Treatment

ESKEL NORDELL

Director of Technical Information, The Permutit Company

INDUSTRY USES 90,000,000,000 gallons of water each working day. Some 10 percent of this tremendous volume is furnished by municipalities, but the other 90 percent is supplied by industry's own water plants.

Whatever its source, water contains impurities. The harmful effects of these impurities depend not only on what impurities they are and what quantities are present, but also on the particular use to which the water may be put. In general, industrial waters may be used for cooling, process, boiler feed, flushing, and other purposes. A water that is eminently suitable for one of these uses in one industry may be entirely unsuitable for the same use in another industry. For instance, muddy Missouri River water may be very suitable, without any treatment whatsoever, for cooling surface condensers in a steam power plant. It may keep the tubes mirror-bright by its scouring action. Yet, it would be unusable for practically all other cooling purposes. If it were to be used as cooling water in certain electro-chemical processes, the mud, hardness, and all mineral would have to be taken out.

Water Clarification

Turbidity and color can be removed by coagulation, settling, and filtration. If only a small amount of turbidity is present, (less than 15 ppm solids), coagulation and filtration may be all that are required. If the amount of suspended solids is large, or if color removal is involved, the inclusion of a settling process is advisable. The usual coagulant is sulfate of alumina, also known as filter alum. Another widely used coagulant is ferric sulfate.

The effect of the coagulant is to produce a gelatinous precipitate that attracts and enmeshes the finely divided insoluble matter. This forms larger aggregations known as "floc" that can be easily removed by filtration or by settling and filtration. The reason for settling is that it relieves the filter of a large portion of the load and thus lengthens the filter runs.

Two types of coagulation and settling equipment are the Floc-former and the Precipitator. In the Floc-former, raw water first enters a chamber in which an agitator rapidly mixes it with the added coagulant. The coagulated water then passes through a series of two or three chambers in which a slow, rolling mix (produced by slowly moving

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Eskel Nordell is the author of "Water Treatment for Industrial and Other Uses," Reinhold Publishing Corp., N. Y. Tables 1 and 3 are reproduced by permission from this book.

paddles) aids in forming a large and easily settled floc. The water then flows through a settling basin where the bulk of the sludge settles out. It then passes to the filters. Fig. 1 shows a Floc-former installation in a Southern textile mill. The Precipitator type of equipment (Fig. 2) is widely used for coagulation and settling and also for water softening.

Filters and Filter Media

The filters may be pressure or gravity type. The filter medium may be sand or non-siliceous in nature.

Non-siliceous filter media are favored for boiler feedwater because they eliminate the possibility of silica pickup. Filtration is effected by flowing the water down through the fine filter medium and its supporting layers of coarser material at flow rates ranging from 0 to 3 gpm sq ft of bed area. If coagulation has been properly carried out, the filtered water should be bright, clear, and practically colorless.

Accumulations of foreign material are periodically removed from the filter bed by back-washing. This is accomplished by sending a strong water current (10 gpm or more per sq ft of bed area) upward through the filter bed. This suspends and separates the granules of the filter medium, lifts and flushes out the foreign matter and hydraulically regrades the bed—thus cleansing and restoring it to its original condition.

Hardness Scale

Hardness in industrial water is usually objectionable for two reasons. First, it forms scale when heated or evaporated. Second, it wastes soap and other detergents.

There is a common misconception that water has to be heated above 130 F to form scale. Many waters that have a high calcium bicarbonate hardness form scale with only a slight warming. In tropical countries, scale formation may take place even in cold water mains.

Scale has an extremely low heat conducting capacity—about the same as firebrick. It would make an excellent insulating material. It forms fastest in just those places where heat units are being passed into the water. That is why scale in steam boilers or water heaters will cause overheating and eventual failure of the metal. Table 1 shows increases in temperature differentials caused by two scales at rates of heat transfer ranging from 2,000 to 140,000 Btu/sq ft per hour.

Scale also clogs hot water piping and fixtures. It does not take thick scale deposits to make troublesome reductions in flow rates. In ¾-inch pipe, for instance, a ¼-inch thickness of scale cuts the effective diameter to ¼-inch. Since the area of a ¼-inch circle is only one-ninth that of a ¾-inch circle, the flow rate is cut to one-ninth of its original value.

The cold lime (or lime soda) water softening process is the oldest process, dating back to 1841.

The lime and soda ash react with hardness in the water to precipitate the bulk of it as calcium carbonate and magnesium hydroxide. Table 2 gives the solubilities of some of the common salts of calcium, magnesium, and sodium. Calcium carbonate and magnesium hydroxide have very limited solubilities.

Types of Equipment

The sludge blanket type of equipment such as the Precipitator (Fig. 2) is widely employed in carrying out this cold lime process. In the Precipitator, the raw water is mixed with properly proportioned amounts of chemicals in the downcomer section. It then rises through a suspended blanket of sludge in another section that is designed so that the cross-sectional area increases with height. As the treated water rises through this section, a plane is reached where its diminishing upward velocity is insufficient to raise the sludge any farther. In practice, there is a clear plane of demarcation between the surface of the sludge blanket and clarified water above.

The chemicals used may be lime and soda ash with a coagulant. If silica removal is required, dolomitic lime or activated magnesia may be used. In general, the cold lime soda softener reduces the hardness of a water to about 4 grains per gallon. Usually filters are used to remove all traces of suspended matter. When a zero-hardness effluent is required, the filtered effluent from the cold process may be passed through Zeolite water softeners. This process is known as the combination lime-Zeolite process.

Hot Lime Soda Softener

The hot lime soda process is often used in softening boiler feedwater. It differs from the cold lime soda process in that

¶ it is carried out at temperatures around the boiling point of water;
¶ it reduces the hardness more;
¶ it requires no coagulant;
¶ it removes silica more economically with dolomitic lime or activated magnesia; and
¶ it deaerates the water.

Hardness may be reduced to less than 1½ grains per gallon without excessive use of chemicals. This can be further reduced to practically zero either by passing the effluent through a sodium-cation exchanger or by second-stage treatment with phosphate.

Without the use of an integral deaerator, the primary heater will reduce the dissolved oxygen to less than 0.3 of a milliliter per liter. With the use of an integral deaerator, the dissolved oxygen will be reduced to less than 0.005 milliliter per liter.

In the hot lime soda water softener (Fig. 3) the water being treated is

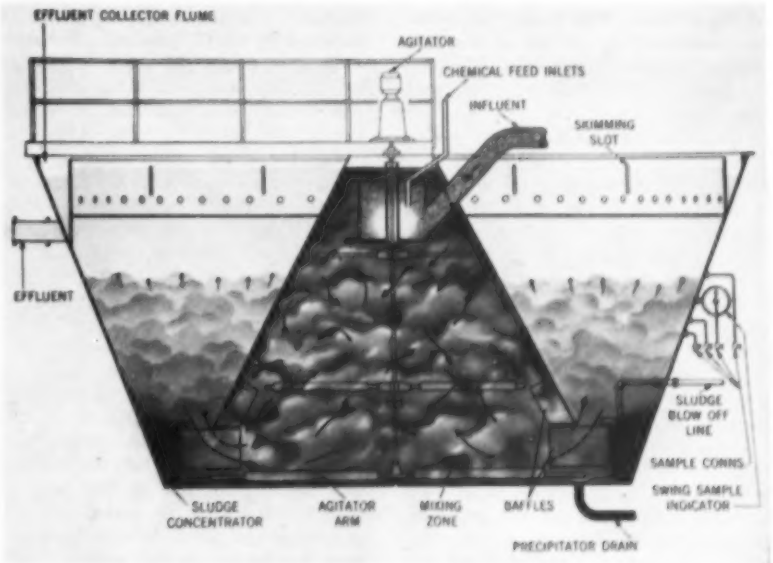

Fig. 2 — Vertical sludge blanket type precipitator is also used for water softening.

TABLE 1 — INCREASE IN TEMPERATURE DIFFERENTIAL CAUSED BY TWO BOILER SCALES WITH DIFFERENT CONDUCTION CONSTANTS

Rate of Heat Transfer (Btu/sq ft/hr)	Increase in Temperature Differential caused by one-tenth in. of scale (F)	
	K = 0.75	K = 1.5
2000	22	11
5000	56	28
10000	111	56
20000	222	111
40000	444	222
60000	667	333
80000	889	444
100000	1110	556
120000	1330	667
140000	1560	778

TABLE 2 — SOLUBILITIES OF COMMON SALTS THAT CAUSE HARDNESS

Name	Formula	Solubility (gpg of $CaCO_3$) at 32F	at 212 F
Calcium bicarbonate	$Ca(HCO_3)_2$	94.5	*
Calcium carbonate	$CaCO_3$	0.9	0.8
Calcium chloride	$CaCl_2$	19600.	32300
Calcium hydroxide	$Ca(OH)_2$	139	51.8
Calcium sulfate	$CaSO_4$	75.3	72.9
Magnesium bicarbonate	$Mg(HCO_3)_2$	2170	**
Magnesium carbonate	$MgCO_3$	5.9	4.4
Magnesium chloride	$MgCl_2$	21100	25900
Magnesium hydroxide	$Mg(OH)_2$	1.0	0.5
Magnesium sulfate	$MgSO_4$	9920	20800
Sodium bicarbonate	$NaHCO_3$	2260	**
Sodium carbonate	Na_2CO_3	3580	16900
Sodium chloride	NaCl	13100	14200
Sodium hydroxide	NaOH	14200	56900
Sodium sulfate	Na_2SO_4	1970	12300

* Decomposes to carbonate

** Decompose first to carbonate and then on boiling to hydroxide

sprayed through an atmosphere of low-pressure steam in the upper part of the softener. This heats the water to almost boiling, drives off the free carbon dioxide, (and often some of the half-bound carbon dioxide), and deaerates the water to less than 0.3 milliliter of oxygen per liter.

As this hot water falls into the upper level of the water in the softener, it is mixed with measured amounts of the chemicals. At the prevailing high temperature, the chemicals quickly react with the hardness to precipitate it as a rapid-settling sludge. The sludge drops to the bottom of the softener and is removed by periodic or continuous desludging. The settled water is then passed through the filters and to service.

If complete deaeration is required, the effluent from the filters is passed to the integral deaerator, where all the steam required for the primary heater is blown through it, effecting a very complete deaeration. From the deaerator it then flows to the service pump and the boiler-feedwater line.

In the Zeolite (sodium cation exchange) process, cold raw water is softened by simply passing it through a Zeolite water softener (Fig. 4). The Zeolite is an insoluble granular substance, about the size of coarse sand. Until recently only siliceous, natural, or synthetic cation exchangers were available. High-capacity, synthetic, sulfonated resins in the form of small, rounded beads are now widely used.

Base Exchange Principle

Upon coming in contact with the Zeolite granules, hardness is extracted from the water by base exchange. Hardness is held by the Zeolite granules. The softening is so complete that the effluent has practically no hardness. When the softening capacity of the Zeolite bed is used up, the softener unit is cut out of service and the Zeolite is regenerated by backwashing, salting, and a final rinsing. Wear and tear on a correctly processed Zeolite is very slight—only from one to three percent per year.

Iron and Manganese Removal

Iron commonly occurs in water and is very troublesome. Manganese is even more troublesome but, fortunately, is much rarer. If these metals are present in surface waters, they are usually present in a colloidal or organic form. They are removed by the usual coagulation, settling, and filtration processes. In ground waters, however, they are usually present in the form of their soluble bicarbonates and must be removed by other processes.

If the water is softened by the Zeolite process, the iron or manganese will be removed along with the hardness bases. Salt regeneration will remove them from the Zeolite.

Iron or manganese may also be removed by aeration (which oxidizes the metals to insoluble substances) followed by filtration. Frequently, and especially in the case of manganese, it is advisable to build up the pH value by adding alkali to increase the speed of the oxidation reactions.

If the iron or manganese content is not over 1 ppm, it may be economical to remove it by filtration through a manganese Zeolite oxidizing filter, which oxidizes the ferrous or manganous bicarbonates to the insoluble higher hydrated oxides. At the same

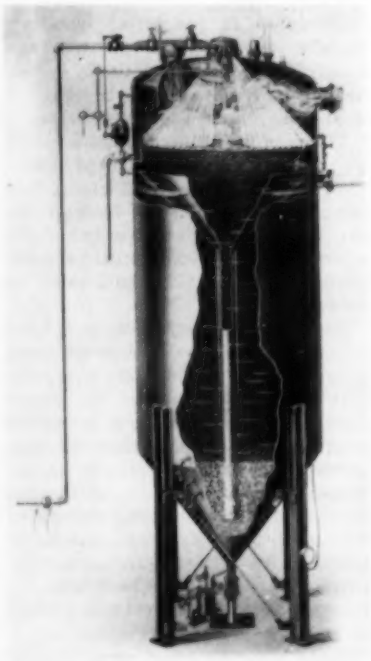

Fig. 3 — Sludge blanket type hot lime soda water softener is a highly efficient unit.

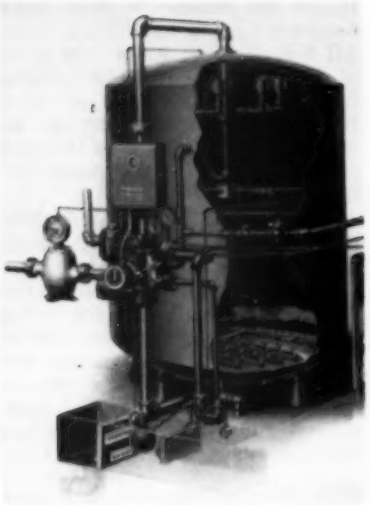

Fig. 4 — Sodium cation exchanger uses Zeolite, can be fully automatic in operation.

time this filter removes them by filtration. These deposits are removed periodically by backwashing. Before the oxidizing power is completely exhausted it is restored by regenerating the filter with potassium permanganate.

Hydrogen Cation Exchange

In the hydrogen cation exchanger process, the exchanger is either of the resin or carbonaceous type because the siliceous Zeolites are unsuitable for use on the hydrogen cycle. In this process, the regenerant is an acid (usually sulfuric). Calcium, magnesium, and sodium are removed from the water in exchange for an equivalent amount of hydrogen ions during the operating run. This forms an equivalent amount of acids corresponding to the salts present in the raw water. In the case of the bicarbonates, the carbonic acid immediately breaks down into water and carbon dioxide, which is easily removed by deaeration. The total solids are therefore reduced by an amount corresponding to the bicarbonate content of the raw water.

The sulfates and chlorides, however, show up in the effluent as equivalent amounts of sulfuric and hydrochloric acids. These must be neutralized before use. This can be accomplished by neutralization of the aerated, degasified effluent with caustic soda, or by the use of both hydrogen cation exchanger units and sodium cation exchanger units. With this system the flows are so proportioned that the sodium bicarbonate content of the sodium cation exchanger effluent neutralizes the acidity of the hydrogen cation exchanger effluent when they are mixed and furnishes whatever degree of alkalinity is required.

When water is passed through a hydrogen cation exchanger, calcium, magnesium, and sodium are removed and held by the exchanger. The bicarbonates appear in the effluent as carbon dioxide, while the sulfates and chlorides form the corresponding amounts of hydrochloric and sulfuric acids. Carbon dioxide can be removed easily by aeration or degasification, but sulfuric and hydrochloric acids are unaffected by such treatments. It is possible, however, to completely remove them by passing the effluent from the hydrogen cation exchanger through an anion exchanger.

These anion exchangers use synthetic resins that are able to remove acids from solution in much the same manner that the cation exchangers remove the basic elements. After use, they can be regenerated with an alkali. The anion exchangers may be broadly divided into two classifications — the weakly basic and the strongly basic.

The weakly basic anion exchangers will remove strong acids like sulfuric and hydrochloric, but will not remove such weak acids as silicic and carbonic. The strongly basic anion exchangers will remove weak acids as well as strong acids. The strongly basic anion exchangers are the ones used in demineralizing boiler feedwater, since they remove the silica content of the water. The regenerant used for the strongly basic anion exchangers is caustic soda. The regenerant used for the weakly basic anion exchangers is soda ash. Several types of hookups are employed. With the weakly basic anion exchangers, the hookup usually consists of a hydrogen cation exchanger, a weakly basic anion exchanger, and a degasifier.

With the strongly basic anion exchangers, the simplest hookup (used mostly where the amounts of water being treated are not very large) consists of a hydrogen cation exchanger unit and an anion exchanger unit. Other hookups are the mixed bed type, in which both the cation and anion exchangers are in one unit; the four-step type, in which the water passes through a hydrogen cation exchanger, a degasifier, an anion exchanger, a hydrogen cation exchanger, and finally through an anion exchanger; and the two-step with degasifier hookup which is the most widely used hookup. The carbon dioxide is almost completely removed by the degasifier.

One of the largest by-product steam plants in the world is that of the Gulf States Utilities at North Baton Rouge. The demineralizing equipment (Fig. 5) consists of eight hydrogen cation exchanger units (each 11 feet in diameter), two vacuum deaerators (each 10 feet in diameter), and eight anion exchanger units (each 11 feet in diameter). The capacity of the demineralizing plant is 5,000,000 gpd. Steam is generated at 1,450 psi and at 950 F. By-product steam is sold to a number of chemical and petro-chemical plants. This station also has an older boiler plant operating at 600 psi. Water for these boilers is softened by a cold lime Zeolite plant with a capacity of 10,000,000 gpd.

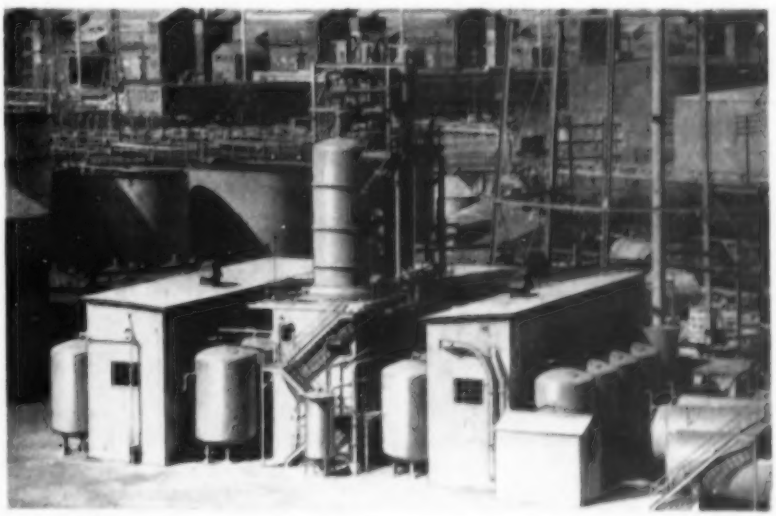

Fig. 5 — Demineralization plant at North Baton Rouge treats five million gallons per day.

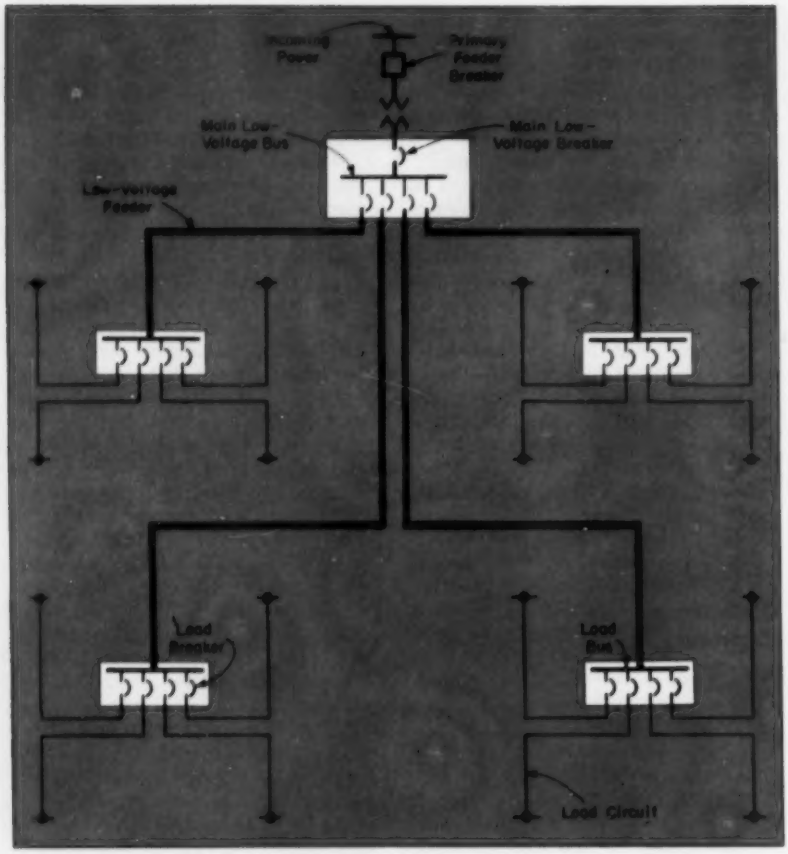

Fig. 1 — Conventional simple radial system is most suitable for plants under 1,000 kva.

Are You Sure That Your Distribution's Up To Date?

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I&P EXCLUSIVE

HOW DO YOU KNOW if your plant's electrical distribution is up to date? The importance of industrial electrical distribution systems justifies periodic investigation to insure that tomorrow's requirements can be met. To determine the condition of your distribution system, try the following questions:

¶ How much capacity does the system now have? Will this be adequate in the light of proposed load additions to the system?

¶ What is the cost of a shutdown that would result from a failure of a system component? Does this cost of an outage warrant a system with greater service continuity?

¶ Are all system components in a safe and reliable operating condition? Do the circuit breakers have adequate interrupting capacity?

¶ Would the normal relocations of various departments cause considerable expense in revamping the system? Based on past experience, should the system be made more flexible?

¶ If the electrical power cost is an appreciable part of the total manufacturing cost, is system efficiency being scrutinized to be sure that the economics of changing to a more efficient distribution system are adequately recognized.

Most of the nation's industrial plants that are 30 or more years old have distribution systems that are inadequate for modern production methods. Consequently, production costs in these plants are higher than need be. Sometimes, this makes the quality of products inferior. A properly engineered, modernized distribution system can overcome these handicaps.

Why Systems Grow Old

Outmoded distribution systems exist in older plants for many reasons. The original system may have met the requirements of the plant at the time it was installed. But subsequent advances in production methods may not have been accompanied by improvements in electrical distribution. As a result, weaknesses in those old systems have become more serious as the years continue to pass.

Due to the rapid and continued advances in distribution engineering, it has become increasingly difficult for all industrial plants to keep abreast of latest developments. This is particularly true of smaller plants. All too often, the precarious condition of the distribution system is not recognized until a serious failure occurs, or until the existing system fails to meet some new load requirement.

In many instances, the system equipment is not safe. Circuit breakers may have inadequate interrupting capacity due to the gradual addition of generation and transmission facilities, or due to addition of step-down transformer capacity at the plant. The location of the system's components—such as oil circuit breakers and oil-filled transformers — may not suit individual plant requirements. Nowadays, air is replacing oil as an insulation medium to reduce fire hazards in many indoor installations—in such equipment as circuit breakers and transformers.

Some plants make frequent changes in the location of their production machinery. The automotive, pharmaceutical, chemical, and petroleum industries are good examples. Some of them are so competitive that a new process can become obsolete before it is completely in-

stalled. Plants faced with this problem should install a distribution system that has flexibility—that is, the ability to meet changing load conditions. Over a period of time, the added first cost to obtain flexibility will be more than offset by the lower cost of each future change.

Need Continuous Power

Most plants employing continuous production line methods or automatic machines need a continuous supply of power. Some examples can be found in paper mills, rubber mills, and chemical plants. In many cases, even a short interruption of power results in a high cost. This cost is made up of three parts: lost man-hours, spoiled product, and downtime on machines.

Since man-hours and machine downtime are increasingly costly, the service continuity in a distribution system should be considered carefully. To assure service continuity, safety, and flexibility, examine the entire distribution system periodically. Particularly study the system whenever major changes are planned — such as large load changes, new manufacturing processes, or new power sources.

Selecting the best system for your plant can be greatly simplified if two major considerations are recognized. Selection amounts chiefly to choosing a good system circuit arrangement and choosing the best voltages.

In determining the system circuit arrangement best suited to many plants, it has been found that the requirements of any plant can be met by one of ten standard distribution systems. For the majority of plants, four of these ten basic systems apply. This is true because the principal requirements of most plant systems relate to just three factors: initial investment, service continuity, and flexibility. Other items—such as regulation, or operation and maintenance costs — are not as vital to most plants though the four popular distribution systems happen to boast all of these features in some degree. They do not necessarily excel in any one of them.

Four Popular Circuits

The four most widely applicable circuit arrangements are the conventional simple radial, the loop primary radial, the banked secondary radial, and the primary selective network.

The conventional simple radial system (Fig. 1) is suitable for most plants where the load does not exceed 1,000 kva. It is the simplest

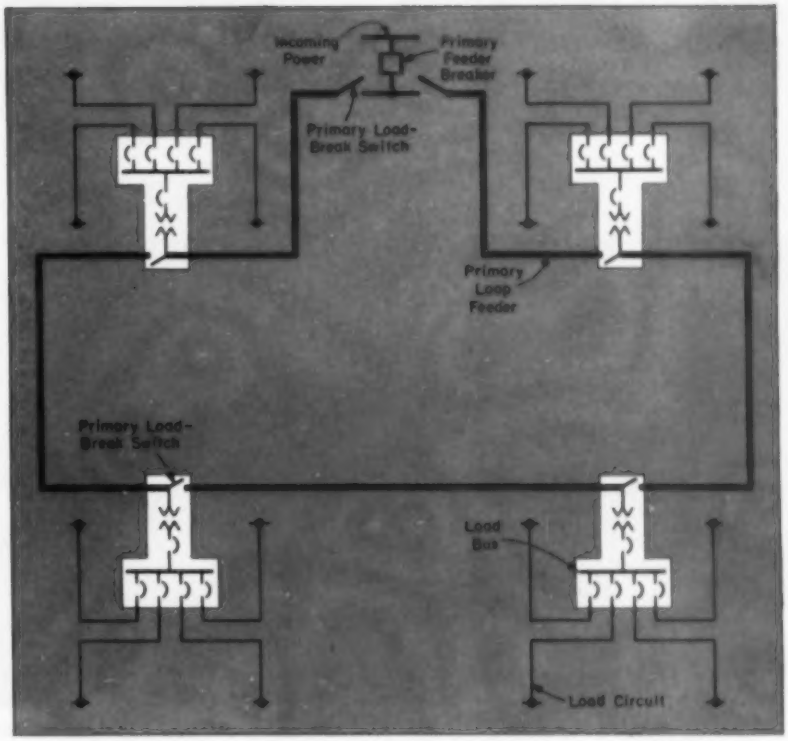

Fig. 2 — Loop primary radial system brings power nearer to load at high voltage. This system has good flexibility and service continuity, and is often the least expensive system.

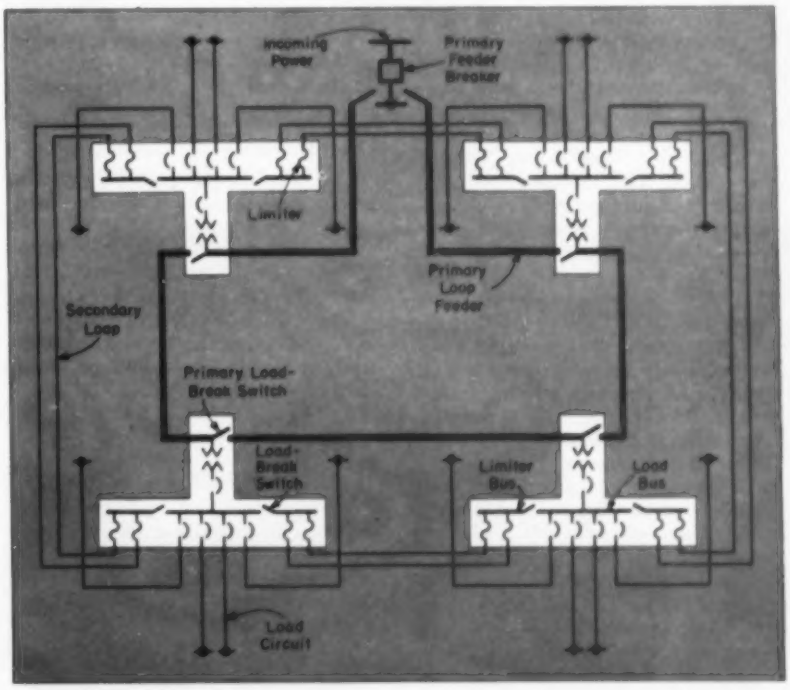

Fig. 3 — Banked secondary radial system depends on secondary ties to enforce sharing of load among transformers. These ties also help out when one transformer is shut down.

Acceptance of dead-front, enclosed unit substations for industrial plants is so widespread that industry buys them almost exclusively today.

and least expensive scheme to meet the needs of a small plant that has no special requirements of flexibility or service continuity.

Prior to 1940, the simple radial system was frequently used in large plants. This is one reason for the inadequacies of distribution systems in some older large plants. The radial system, with its poor flexibility, cannot readily adapt itself to changing load conditions since major additions of load require additions of feeders and feeder breakers. This usually makes feeders too long.

The simple radial system also offers but poor service continuity since a failure in the primary feeder, the transformer, the main transformer breaker, or the secondary bus results in a complete plant shutdown. Service cannot be restored until some emergency source is supplied, or until the faulted equipment has been removed, repaired, or replaced.

Old radial feeders are usually made of rather heavy copper and supply considerable load. Thus, a rather extensive outage occurs upon a feeder fault. Frequently, regulation is also a problem with the old radial system when the feeders are rather long. Despite these disadvantages, this system is still quite adequate for many small plants. It is particularly attractive from a first-cost viewpoint.

The other three systems primarily apply to large plants where the load exceeds 1,000 kva, and to smaller plants with special requirements.

Loop Primary

The loop primary radial system brings power nearer to the load center at high voltage (Fig. 2). This scheme has good flexibility and service continuity. The flexibility is obtained from the fact that the primary feeder can be tapped at any point along its course for another substation to supply any additional load that might arise.

Service continuity follows from the fact that a primary feeder fault, or a transformer fault can be isolated by the switches in the primary loop. Only that small portion where the trouble actually exists will remain out of service until repairs are completed. For a large plant, this system is frequently the least expensive to install.

When Flexibility is Important

If flexibility is the principal requirement, the banked secondary radial system (Fig. 3) will provide it at minimum cost for most plants. Flexibility stems from the secondary ties that connect all the low-voltage busses together so that the transformers aid each other in carrying the load. Even though the load may double at some location, the load on the substation in that area will not necessarily double since the secondary ties enable the adjacent substations to share some of the added system load.

If your particular plant also needs optimum service continuity in addition to flexibility, the primary selective network system is recommended (Fig. 4). In addition to the transformer secondaries being tied together to aid one another, there are two primary feeders. Network protectors are used in place of transformer secondary breakers.

The network protector contacts open on a reversal of current and automatically reclose whenever voltage conditions are such that power will flow in the normal direction. Thus, a fault in a primary feeder or transformer will not result in a service interruption. The fault is isolated automatically by the operation of the primary feeder breaker and those network protectors that are fed from the faulted feeder. Since manually operated high-voltage switches are included, all units can be switched

to the remaining primary feeder until repairs are completed.

A light metal fabricating plant is shown in Fig. 5. The original system is shown in white line. The proposed system and plant layout are shown in black lines. The principal load centers are shown in peak diversified demand where they occur. The black lines show the high-voltage distribution system in single-line form. The transformer sizes are shown beside the substations.

Changes in the distribution system were necessary because contemplated additional loads would have exceeded the existing distribution system transformer capacity. An investigation showed the system components to be inadequate and unsafe. This plant required reasonably good service continuity and low first cost. The first cost was most important. Service continuity was not as important since the entire plant did not run on a continuous production basis, and only a small amount of material would have been spoiled in the event of a temporary electrical system shutdown.

Loop Primary Wins

The four systems already mentioned were considered for this plant. The conventional simple radial was not adequate since the load was approximately 2,550 kva. The loop primary radial system had ample service continuity and was the least expensive system that could be installed in most plants. In this case, the loop primary radial system (solid lines) fits into the plant's physical layout satisfactorily. Since there are no important demands for features other than low first cost and reasonably good service continuity, there was no reason to install either the primary selective network or banked secondary system.

The other important consideration in keeping the systems up to date is the selection of the most economic primary and secondary voltages. Usually 2,400, 4,160, or 13,800 volts should be used for the primary distribution voltage. Plants with a load of 5,000 kva or more generally can be served most economically at 13,800 volts.

In smaller plants, the choice between 2,400 and 4,160 volts is determined by the percentage of motors rated 200 hp and above. This large-motor load must constitute at least 25 percent of the total load to make 2,400 volts worth considering. Of course, incoming supply voltage and existing equipment must be considered in the final selection.

Nominal three-phase utilization voltages found in existing plants are 208Y/120 volts, 240 volts (delta), 480Y/277 volts, and 480 volts (delta). Unless all the motor load is 10 hp and below, either 480Y/277 volts or 480 volts (delta) will be most economical. The choice between 480 volts (delta) and 480Y/277 volts is determined by the amount of 277-volt lighting load and/or whether a grounded system is required.

Usually, a change of secondary voltage in an existing plant is difficult to justify unless a major addition of load takes place simultaneously with the system change. It is usually less expensive to design the distribution system for the existing operating voltage than it is to make motors and controls suitable for a new voltage. Trends continue to higher secondary voltages.

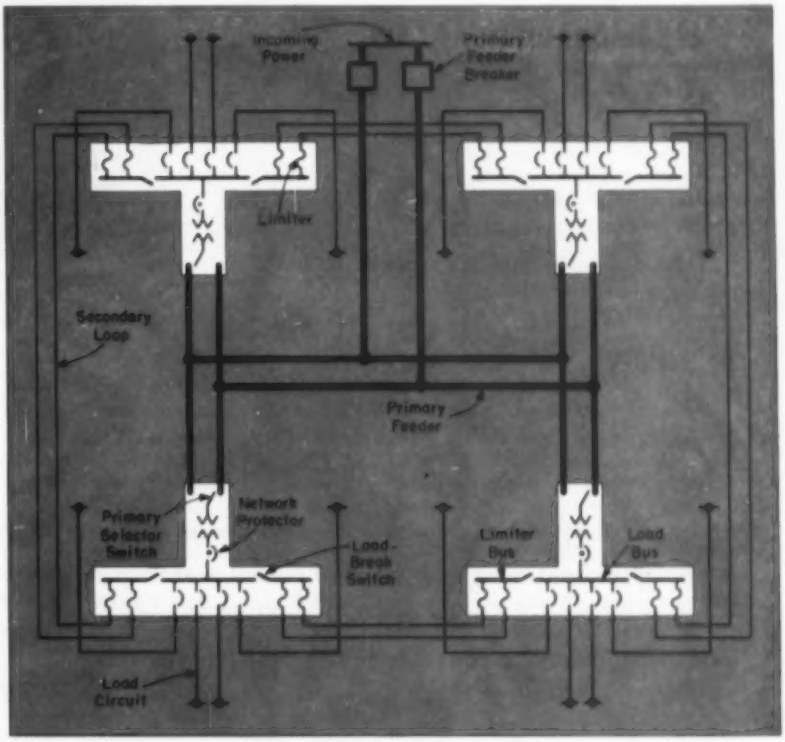

Fig. 4 — Primary selective system gives utmost continuity through use of double primary feeders, secondary ties, and network protectors to prevent reverse power flow into faults.

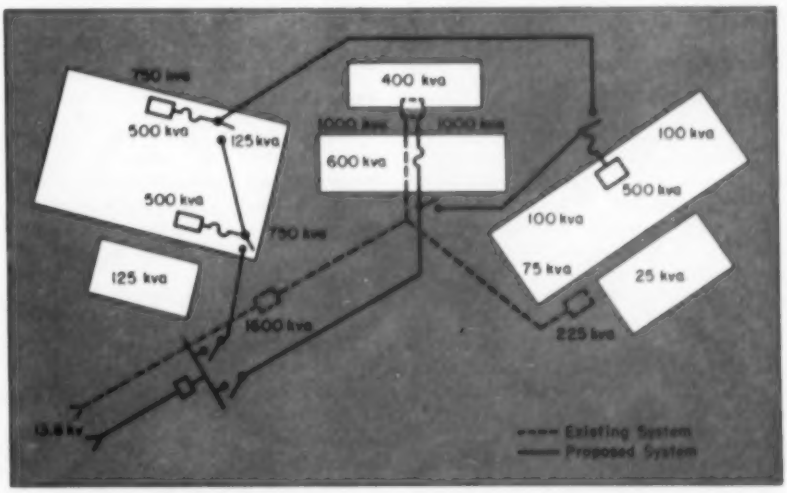

Fig. 5 — Problem in fabricating plant was that existing transformer capacity would be exceeded. Loop-primary radial proved best on basis of service continuity and installed cost.

Automatic Control For Variable Speed Transmissions

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Fig. 1—Link-Belt unit uses electronically controlled reversing electric pilot positioning motor to actuate speed changing mechanism.

I&P EXCLUSIVE

Mechanical power transmission is becoming more and more sophisticated as time goes by. Speed control of these transmissions is one refinement that has received considerable attention. Automatic control is getting even more attention.

COMPLETELY AUTOMATIC factories are still few and far between. Most manufacturing operations still have many parts of their total process under manual control, but every year more of these manual operations become automatically controlled.

In every industry, machinery has to be driven, and the driving energy is usually provided by an electric motor. One of the oldest, and still the most popular, forms of variable speed mechanism consists of a constant speed electric motor and some mechanical device that varies the speed between its own input and output shafts. Until recently, mechanical variable speed drives were not readily adaptable to automatic control. There were no industrial models available wherein the speed ratio could be actuated by common process variables—temperature, flow rate, viscosity, pH, and so forth.

The most common form of variable speed mechanism consists of two parallel shafts with variable pitch sheaves mounted on each shaft. A V-belt connects the two sheaves. Speed change is effected by simultaneously enlarging the pitch diameter of one sheave and reducing the pitch diameter of the other.

Early Models

One of the earliest forms of automatic control for variable speed transmissions uses reversing, electric pilot positioning motors to actuate the speed-changing mechanism (Fig. 1). The pilot motor is operated by an electronic control system, which amplifies the signals received from the process variable.

The electronic control system uses two potentiometers to form a bridge circuit. One potentiometer, known as the "transmitter," moves in direct response to the process variable. Movement of this potentiometer actuates the pilot motor. The second potentiometer is known as the "follower." It is driven by the pilot motor, as is the speed-changing mechanism. Movement of the follower potentiometer tends to balance the voltage of the transmitter potentiometer. The system is designed so that the follower moves the same amount as the transmitter. Thus, the speed of the variable speed transmission is changed by an amount that is proportional to the movement of the transmitter potentiometer.

Without this follow-up principle, the pilot motor would shift the transmission all the way to maximum or minimum speed, since complete shifting takes only a few seconds. A pilot motor could not be actuated directly by the process variable. Without follow-up, two potentiometers and an electronic control system are necessary for satisfactory operation.

These control systems are inherently of the on-off type, but this type of control is vastly different from the familiar on-off type of control for valves. A valve is either fully closed or fully open. With a variable speed transmission, the situation is quite different. The output shaft never stops rotating. Actuation of the pilot motor simply changes the output speed of the unit.

Needs Direct Linkage

The process variable in control must be linked directly to the transmitter potentiometer. Force necessary to turn this potentiometer usually is about one ounce. The con-

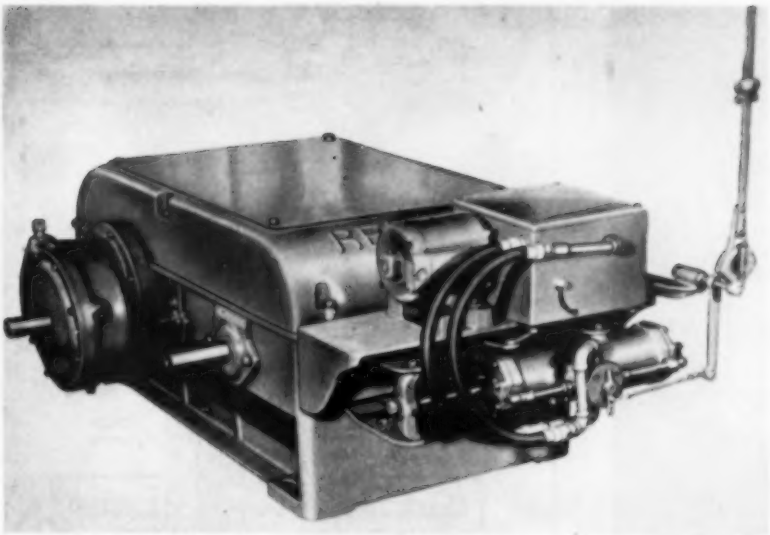


Fig. 2 — Reeves Pulley automatic control uses double acting hydraulic cylinder with 4-way valve mounted on moving part. Follow-up principle limits speed change to required amount.

trolled variable, therefore, must be capable of producing a rotary or linear force of at least an ounce.

One of the most common applications of this type of automatic control is in maintaining desired tension in web materials, such as paper, coated fabrics, and plastic films. Since tension is the longitudinal force in the web, the web is run over a movable roller that measures the tension. The roller is either mounted for vertical movement in a "dancer" roll stand, or the roller is pivoted. The movable rollers are balanced by weights, and the potentiometer is linked to the roller so that movement of the roller moves the potentiometer.

There are two basic applications for such web tension control. One is in winding web materials after they leave the processing machinery. If constant tension is required, then the horsepower applied to the winding roll must be maintained constant. To accomplish this, the torque applied to the roll shaft must be continually increased as the winding roll becomes filled. The movable roller actuates the variable speed transmission so that constant tension is maintained exactly.

Used For Synchronization

Another application for constant tension control is in the synchronization of two or more machines that are continuously processing web materials. The exact control of the tension may not be of prime importance, but it is a very convenient means for producing the desired results. The movable roller is placed between the first and the second machine, and it controls the speed of the second machine. If the first machine slows down, the automatic control slows the second machine. Where there are more than two machines, the same type of control is used for succeeding machines. Such systems are known as "range drives."

Liquid Level Control

Another variable that can be controlled by this dual potentiometer and electronic amplification system is liquid level. The variable speed transmission drives a pump feeding a tank, and a float moves the transmitter potentiometer.

Pressure can sometimes be controlled by a potentiometer system. One example is the control of an automatic boiler stoker. A pressure-sensitive diaphragm moves the transmitter potentiometer and the variable speed transmission drives the stoker.

Another type of automatic control for variable speed transmissions was introduced just over ten years ago. This is the hydraulic control system. A double-acting hydraulic cylinder is connected to the speed changing mechanism and is controlled by means of a delicate four-way valve. The valve, in turn, is operated by a lever (Fig. 2). The control valve is usually mounted on a movable part of the cylinder. As the cylinder or piston moves, the valve lever is automatically returned to the neutral position. Without this feature, movement of the valve lever would shift the transmission either to maximum or to minimum speed. Using the follow-up principle, the speed is changed by an amount porportional to the movement of the valve lever. Functionally, the valve replaces the potentiometer described previously. The principle of hydraulic follow-up is the same as electronic control using two potentiometers.

Needs Some Force

Since a force of an ounce or so is required to move the hydraulic valve lever, applications suited to hydraulic control are the same as with the potentiometer control — tension, liquid lever, and certain pressure problems. Hydraulic control, however, has several advantages over electric control. Hydraulic control can be used in explosion-proof installations, and suffers none of the inherent disadvantages of the electric control. A tube or fuse failure can put the whole electronic control system out of operation. Discovery of the trouble often can be a difficult chore.

It would seem that speed control could be easily made automatic by simply adding a diaphragm motor for controlling the speed-changing mechanism, and by then controlling this motor with a pneumatic controller. Generally, though, the diaphragm motor has neither the travel nor the power to shift most transmissions. Development of a pneumatic control cylinder, recently, has completely revolutionized the picture of automatic speed control. By adding a control cylinder to a vari-

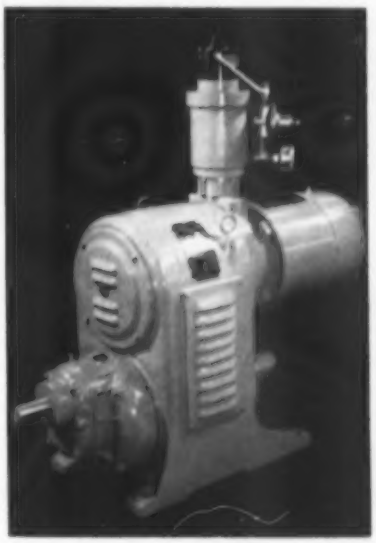


Fig. 3 — U. S. Electrical Motors unit uses air-operated Conoflow control cylinder.

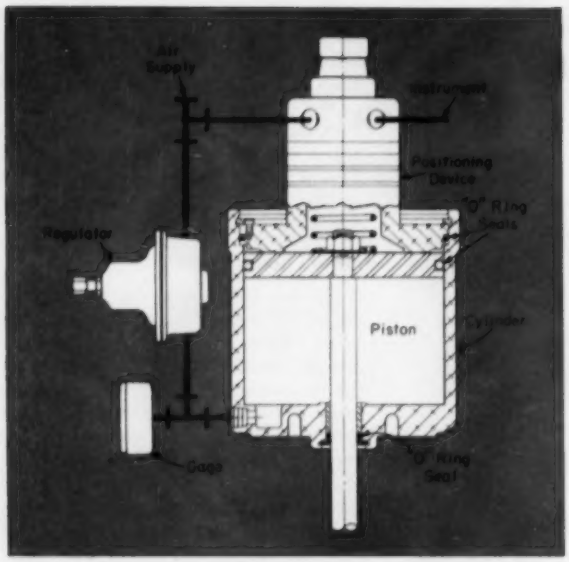


Fig. 4 — Conomotor, basically a simple pneumatic cylinder with integral valve positioner, is standard equipment on many units.

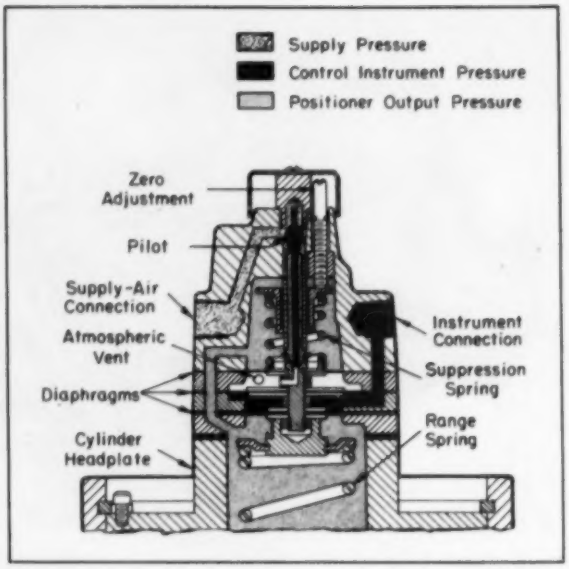


Fig. 5 — Construction of cylinder head is shown here. Range spring presses on piston, which is air-cushioned underneath.

able speed unit, the transmission can be actuated in the same manner as a diaphragm control valve is actuated by any pneumatic controller sensitive to temperature, pressure, flow rate, humidity, pH, liquid level, viscosity or other variables.

These control cylinders basically consist of a simple pneumatic cylinder with an integral "valve" positioner. The positioning device is actuated directly by instrument air pressure from a pneumatic controller. The underside of the piston is loaded by a "cushion" of low-pressure air that takes the place of the spring found in the conventional diaphragm valve. The valve of the positioner admits 80 to 100 psi compressed air on top of the piston to move the stem downward. Since the air volume required for full travel is small, and since high-pressure air is used, the response speed is five to ten times faster than the conventional spring and diaphragm motor. Beside this, standard stem travel of this device is three to four inches. The speed of response, length of stem travel, power, accuracy, and stability of it all tend to make the device readily adaptable to variable speed transmissions that use automatic control.

Positioner Is Pilot Valve

The positioning device is simply a delicate pilot valve that introduces high pressure air to the top of the cylinder (Fig. 4). When moving in the opposite direction, the positioner releases the air from the top of the cylinder so that the cushion air pushes the piston in the opposite direction. One of the characteristics of such an arrangement is that for any signal air pressure, there is a definite position of the cylinder stem. This produces a minimum of hunting action.

Air is admitted to the bottom side of the piston by a reducing-relief type regulator. When the piston moves down, air is bled to the atmosphere. When the piston moves up, fresh reduced-pressure air is fed in. The underside piston pressure is therefore maintained at the same value at all times. This pressure loading is much more desirable than spring loading when such long stem travel is required.

From an initial cost comparision, it would not seem that the diaphragm motor valve could ever be replaced by an automatically controlled variable speed transmission, but there are many instances where results can be obtained that are not possible with the simple control valve. This is true in the precise control of fluid flow.

One of the accepted methods for controlling fluids in continuous processes has been to pass the fluid through a centrifugal pump and to control the flow by means of a diaphragm control valve that could be actuated by temperature, pressure, or any other variable. Now this method is challenged by the automatically controlled variable speed unit. A positive displacement pump can be driven by a pneumatically controlled variable speed mechanism, with results superior to those that can be obtained with the diaphragm valve.

Now Standardized

Standardization on control cylinders for automatic variable speed units is a recent development. Most applications so far have involved pumping operations for handling fluids in proportioning and similar applications. In the future we can expect to see these control systems used more and more as the prime movers for many types of manufacturing machinery. Agitators, mixers, stokers, chemical feeders, conveyors, calendars, textile equipment, and paper machinery are some of the equipment that can be controlled by automatic speed control units. Mixers and agitators can be controlled according to the viscosity, specific gravity, or other variables in the system. Textiles, plastic films, rubber, and paper machinery can be directly controlled by the hardness, thickness, dryness, stretch, or other physical properties of the material being processed.

One of the main limitations of this type of automatic speed control would seem to be the limited ratio of some variable speed units. There is no doubt that mechanical variable speed has become a definite factor in automatic control and as such is a new tool for the plant engineer.

One building containing an engine pump room, auxiliary room, and control room houses all major equipment at Vicksburg booster station.

Automatic Operation and Remote Control For

Wolverine Diesel Pumping Station

L&P EXCLUSIVE

CHESTER CURVEY, Chief Operator

WOLVERINE Pipe Line Company's Vicksburg Station exemplifies modern engineering practices in the design of pumping installations. Arranged for flexibility, reliability, and safety, this station can be pushbutton actuated by the operators at Vicksburg or remotely controlled via teletype hookup from Wolverine's Kennedy Avenue Station, over 100 miles away in Hammond, Indiana. Safety devices protect all major station components, and they immediately shut down the station if there is any departure from normal operation.

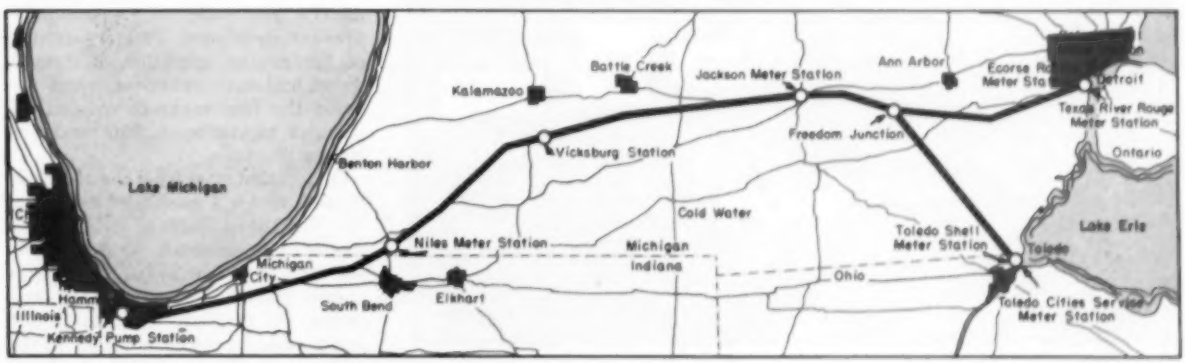
Wolverine System Details

As shown on the map, Vicksburg currently is the sole booster station in the entire 295 miles of 16-in. welded steel pipe line in the Wolverine system. Initial pressure is developed at the Kennedy Avenue Station, the starting point for the pipe line. Jointly owned by Cities Service Oil Company, Shell Oil Company, and the Texas Company, the pipe line is a common carrier available to all shippers and subject to the regulations of the Interstate Commerce Commission. The system receives products through private feeder lines from the Cities Service refinery, and the Shell and Texas terminals, in nearby East Chicago, and delivers them through any one of seven meter stations to shipper's terminals at Niles, Jackson, and Detroit, Michigan, and Toledo, Ohio.

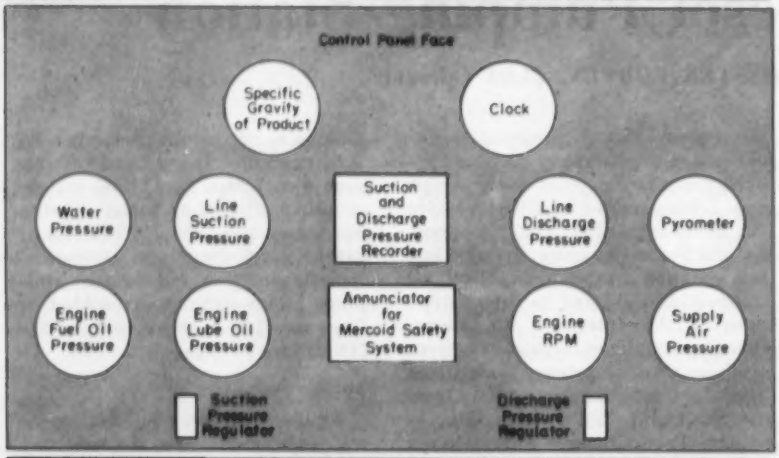
With the present arrangement of surface installations, the Wolverine system has a capacity of 4,000,000 gallons of petroleum products a day. It is currently being used to transport diesel fuel, No. 3 fuel oil, premium and house brand gasoline, kerosene, and prime white. In the future service may be extended to include propane and butane, and if more pump stations are added, the line capacity can be boosted to 7,350,000 gallons per day.

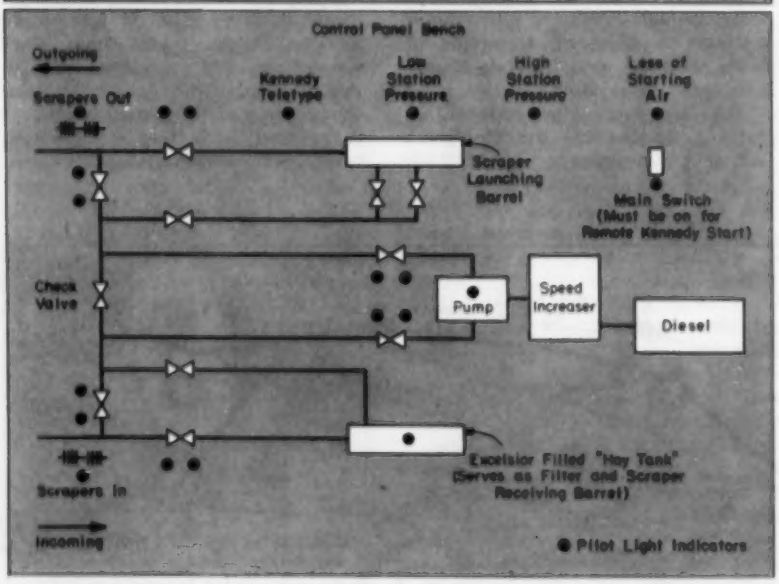
Station Arrangement

At the Vicksburg Station, operating components are housed in a single building, divided into three sections: engine-pump room, auxiliary room, and control room. With this arrangement a total personnel complement of three men is all that is required. Each lives in a modern, brick home on the station grounds.



Wolverine pipeline system currently includes 295 miles of 16-in. pipe line, two modern pumping stations, and seven metering terminals.





Control room at Vicksburg pumping station contains the teleprinter and control panel. Drawings show details of the instruments and the station diagram on the control bench.

While the operators' primary duties are supervision of the station performance and routine maintenance of equipment, buildings, and grounds, their work also includes certain other responsibilities. Since the line handles a variety of products, the separation of these products is a foremost requirement, and it is accomplished under controlled conditions of operation. Certain products are proceeded and followed by scrapers which are received at Vicksburg in an excelsior-filled "hay tank," with an identical set being subsequently launched into the outgoing line for continued movement east. This operation normally takes 7 or 8 minutes.

Station Equipment

An engine driven, two stage United Iron Works centrifugal pump rated 3220 gpm at 2152-ft head is the principal operating unit at the Vicksburg Station. Power is supplied by a 12 cylinder, 2650 hp, Nordberg, V-type, four-cycle, Supairthermal diesel engine, through a Farrel-Birmingham 10.189 to 1 (500 to 5094 rpm) high speed herringbone gear speed increaser. The engine is presently operated up to 2000 hp without intercooling, but the available intercooling facilities increase its rating to 2650 bhp, equivalent to 160 bmep.

The engine has 12 cylinders of 13-in. bore and 16½-in. stroke and features high pressure turbocharging, intercooling, and variable compression ratio. At the operating speed of 5094 rpm, the pump develops as much pressure as two identical pumps in the Kennedy Station that operate at 3600 rpm. In the future it is planned to install a 3 to 1 pressure ratio turbocharger and increase the rating of the engine to 3200 bhp, equivalent to 190 bmep.

Operating Cycle

Application of the Norris Plank control system is the key to the automatic characteristics of the Vicksburg Station. With this system, the usual engine governor serves only to prevent overspeed. Primary control of the engine operation is through direct hydraulic cylinders, which position the fuel racks in response to changes in station suction and discharge pressure.

On a dialed start from the Kennedy Station or on a pushbutton start at the Vicksburg Station, an electrical sequence is initiated to selectively open the pump suction and discharge valves; start the circulation of lubricating oil through the engine and pump seals; apply starting air to the engine; and, by action of the hydraulic control, open the fuel racks. This

last phase of the sequence is initiated when the start cylinder receives air through a solenoid valve, extending its piston to open the fuel rack wide at the same moment as starting air is admitted to the engine.

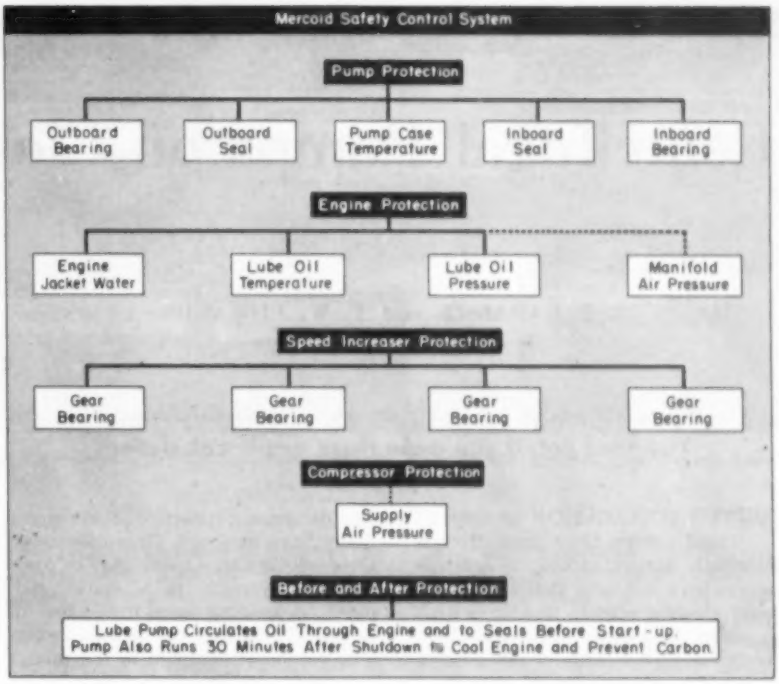
When the engine fires (this occurs within 90 seconds after dialing a start) and differential pressure across the main pump increases, the solenoid valve to the idle cylinder opens, admitting air to retract the fuel rack to idle position. After a delay through an electric timer, the air is released at a controlled rate by means of a time tank. This allows the engine to make the transition from idle to control speed over a period of approximately five minutes to insure time for warmup of a cold engine and to permit gradual application of load.

Panel Controls All Operations

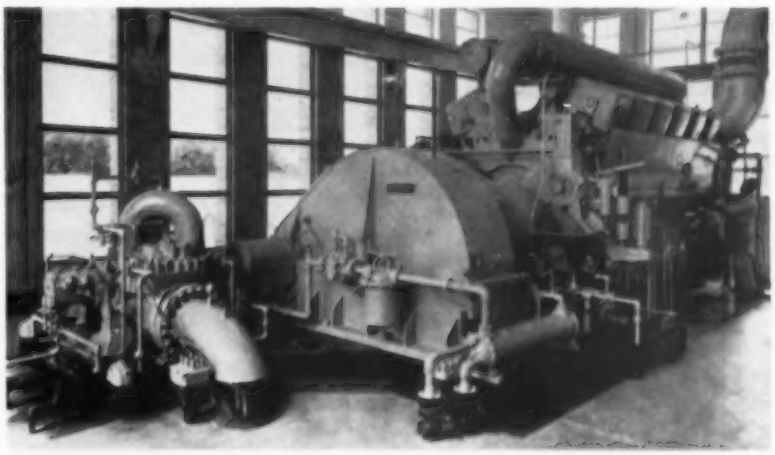
The result of all operations is immediately apparent to the operators by examining the instruments on the control panel. In addition, the Kennedy operator can selectively dial the Vicksburg Station to obtain a reading of the pressure boost which the pump is adding to the line without calling on the Vicksburg operator for this information.

Safety devices at the station protect all major components of the system. The chart indicates the extent of the safety protection. If trouble develops, a loud alarm alerts the operator, and he can check the annunciator on the panel to see which safety device has cut out. Also, after an engine shutdown the lubricating oil pump continues to run for 30 minutes to cool the engine and prevent carbon.

While jointly owned, design and construction of the Wolverine system was in charge of the Shell Oil Company. Shell's Products Pipe Line Department, which has its headquarters in Radio City, New York, also schedules all product movements and other routine operations of the Wolverine system.



All safety devices, except the Mercoids on the manifold air pressure and the supply air pressure, will shut down the engine if operating trouble develops within the pumping station.



A 12-cylinder 2650-hp Nordberg V-type, four-cycle diesel engine drives the United Iron Works centrifugal pump through Farrel-Birmingham high speed herringbone gear speed increaser.

PRINCIPAL EQUIPMENT

Diesel engine	Nordberg Manufacturing Co.	Lube oil filter	The Hilliard Corp.
Speed increaser	Farrel-Birmingham Co., Inc.	Lube oil cooler	Kewanee-Ross Corp.
Pipe line pump	United Iron Works Co.	Temperature regulating valve	Amot Controls Corp.
Flexible coupling	Thomas Flexible Coupling Co.	Air compressor	Gardner-Denver Co.
Governor	Woodward Governor Co.	Fuel oil meter	Ralph N. Brodie Co.
Turbocharger	The De Laval Steam Turbine Co.	Before and after pump	Northern Ordnance Inc.
Flexible connector	Zallea Brothers	Magnetic strainer	Nordberg Manufacturing Co.
Expansion joint	Bishop & Babcock Mfg. Co.	Safety Controls	The Mercoid Corp.
Blower	American Blower Corp.	Pyrometer	Alnor Instrument & Pyrometer Co.
Intake air filter	Air-Maze Corp.	Speed indicator	Weston Electrical Instrument Corp.
Exhaust silencer	Maxim Silencer Co.	Pressure recorder	The Foxboro Co.
Fluid cooler (radiator)	The Trane Co.	Service crane	Manning, Maxwell & Moore, Inc.

How to calculate temperature rise in

I&P EXCLUSIVE

Centrifugal Pumps on Closed Discharge

I. J. KARASSIK and T. W. EDWARDS
Worthington Corporation

Worried about pumping against closed discharge? You need not, if you make these simple calculations

BETTER UTILIZATION of centrifugal pumps can come from a thorough understanding of certain operating conditions that have long been thought utterly unwise — such as operating a pump against a closed discharge valve. This is not always the dangerous practice that engineers have assumed. Operation with a closed discharge valve may or may not be injurious to a centrifugal pump, depending upon a number of factors. Although the pump casing will not burst, damage to the pump through overheating is a definite possibility (in some cases) unless proper bypass precautions have been taken for the pump.

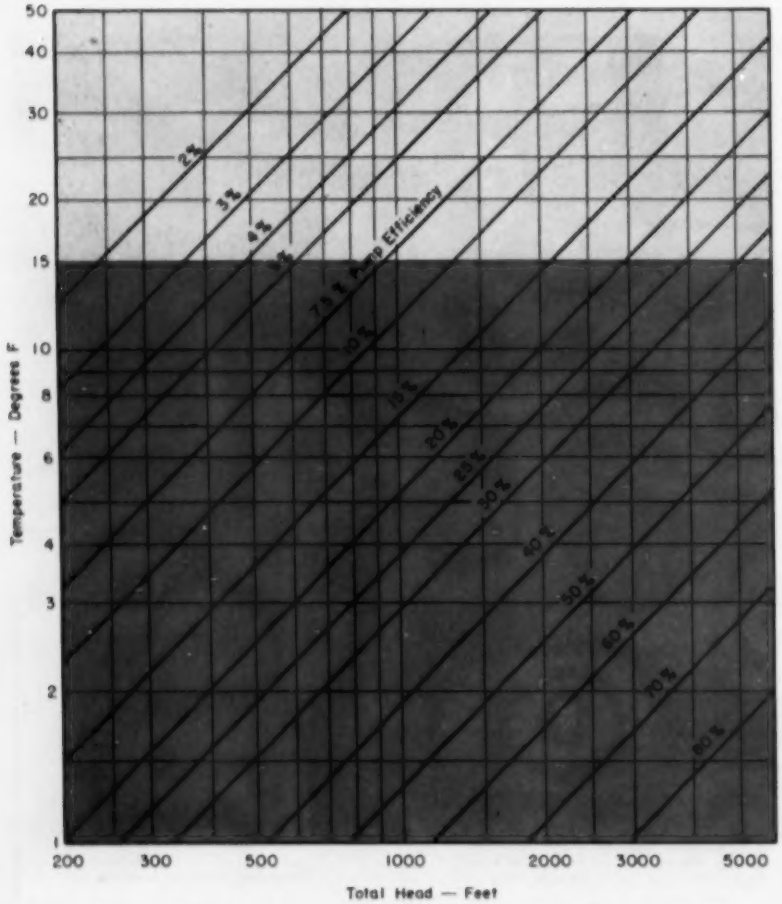


Fig. 1 — Temperature rise, shown as ordinate, is linear with total head and efficiency.

The difference between the brake horsepower consumed in a centrifugal pump and the water horsepower developed represents the power loss within the pump itself. All this power loss is converted into heat and is transferred to the liquid passing through the pump.

There is a definite amount of brake horsepower being delivered to the pump. The pump develops a fixed, but lesser amount of, water horsepower. A fixed amount of horsepower is converted to heat and raises the temperature of the water being pumped. A certain amount of the heat is radiated from the pump casing. The temperature rise of the water passing through the pump and the outlet temperature of the water are determined by capacity and inlet temperature.

The heat dissipated through radiation and convection from the pump casing may be considered negligible as long as there is some flow through the pump. The effects of liquid compressibility also can be disregarded for our purposes.

Assuming that the specific heat of water is 1.00 for all the practical ranges of pumping temperatures, the temperature rise at any rate of flow can be calculated from the relation:

$$\text{Temperature Rise} - F = \frac{(\text{bhp} - \text{whp})\ (2545)}{\text{pump capacity}}$$

where 2545 = Btu equivalent of 1 hp-hr
pump capacity = lbs per hour.

If the incoming water temperature varies over an operating range, such as it frequently does in boiler feed service, converting capacity ratings from "gpm" to "lbs per hr" can become fairly tedious. In addition, the calculation of the pump water horsepower must be carried out at several capacities. This water horsepower then must be subtracted from pump brake horsepower in order to deter-

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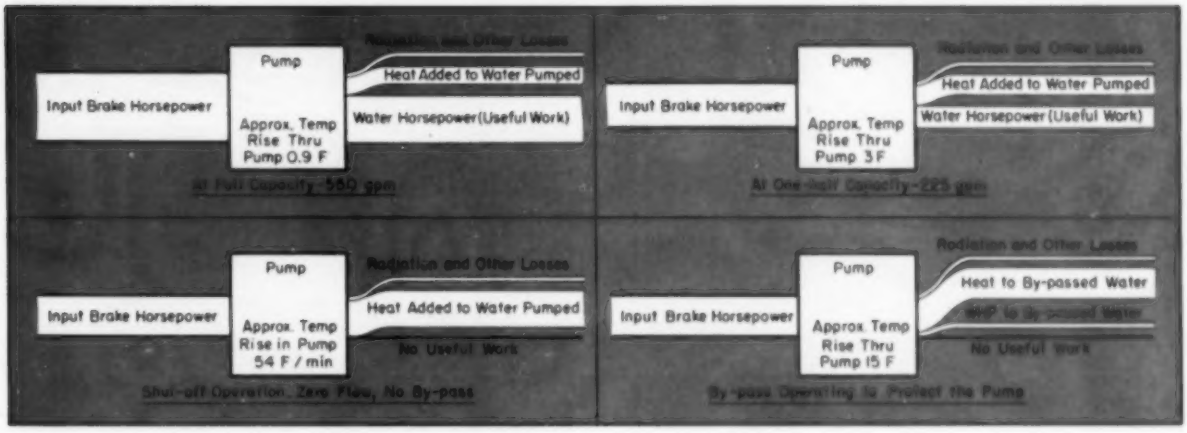

Input Brake Horsepower
Pump
Approx. Temp Rise Thru Pump 0.9 F
Heat Added to Water Pumped
Water Horsepower (Useful Work)
Input Brake Horsepower
Pump
Approx. Temp Rise Thru Pump 3 F
Heat Added to Water Pumped
Water Horsepower (Useful Work)
Input Brake Horsepower
Pump
Approx. Temp Rise in Pump 54 F / min
Radiation and Other Losses
Heat Added to Water Pumped
No Useful Work
Input Brake Horsepower
Pump
Approx. Temp Rise Thru Pump 15 F
Radiation and Other Losses
Heat to By-passed Water
No Useful Work

Fig. 2 — Graphical representation of division of input brake horsepower into heat and other losses at different flow rates through pump.

mine the heat-horsepower, which is used to determine temperature rise.

Fortunately, the formula used to determine the temperature rise can be simplified to a great extent:

$$\text{Temperature rise —F} = \frac{(\text{bhp} - \text{whp})\,(2545)}{\text{pump capacity}}$$

$$= \frac{\text{whp}\left(\frac{\text{bhp}}{\text{whp}} - 1\right)(2545)}{\text{pump capacity}}$$

$$= \frac{(\text{gpm})\,(\text{total head in ft})\,(\text{sp gr})}{3960}\left(\frac{1}{\text{eff}} - 1\right)(2545) / (\text{gpm})\,(500)\,(\text{sp gr})$$

$$= \frac{\text{Total Head in Ft}}{778}\left(\frac{1}{\text{eff}} - 1\right)$$

where eff = pump efficiency.

Since a pump performance curve generally shows the total head and the pump efficiency at any given capacity, the temperature rise at that capacity can be calculated easily. Fig. 1 shows a graphical representation of this formula and may be used to determine the minimum permissible capacity once the maximum permissible temperature rise has been specified.

Power Goes to Heat

When the pump is operating at shutoff, however, the power losses are equivalent to the shutoff brake horsepower. Since no flow is taking place, all the power delivered to the pump goes into heating up the small quantity of liquid in the pump itself. Under such conditions, no equilibrium exists immediately. Instead of a fixed temperature at the pump outlet, the temperature rises with time. If we neglect the effect of heat dissipation through radiation and convection, the approximate relation for the temperature rise for operation at shutoff is:

$$\text{Temperature rise —F per min} = (\text{bhp at shutoff})\,(2545) / [\text{wt of bare pump} \times C_p) + \text{wt of water in pump}]$$

$$= (\text{bhp at shutoff})\,(42.4) / [(\text{wt of bare pump} \times C_p) + \text{wt of water in pump}]$$

where C_p = the specific heat of cast iron (about 0.13)

This formula includes a factor to account for the effect of the casing and internal parts on the absorption of heat as well as for the weight of the water within the pump. But the effect of this absorption factor is slight in relation to the effect of the weight of the water. The formula can be greatly simplified without detracting from its accuracy.

If the absorption is included though, such complicating factors as differing materials of construction, bearings, and so on can be eliminated within the degree of accuracy desired. The weight of the pump alone (without baseplate, motor, or coupling) can be used. The use of the specific heat of cast iron can be used to represent the entire weight where cast iron predominates.

For example, let us assume that the brake horsepower of a pump at shutoff is 100. If the pump contains 100 pounds of water and if the bare pump weight is 500 pounds, the temperature will increase at a rate of 26 F per minute. If, on the other hand, the pump in question is a low-head, high-capacity unit that weighs 2,000 pounds and contains 5,000 pounds of water, the rate of temperature increase will be only 0.85 F per min.

It becomes apparent that when the volume content of a pump is very small (as in the case of high-pressure, high-speed pumps) overheating is very rapid. A large-capacity, low-head pump with the same total power losses may operate against shutoff for hours before anything untoward would happen.

Certain types of centrifugal pumps, however, cannot be operated at or near shutoff conditions for purely mechanical reasons. In most single-stage volute pumps, for example, the volute is not symmetrically disposed around the impeller. There is an inequality in pressure distribution over the 360 degrees of the volute. This sets up a hydraulic force called "radial reaction" that is a function of the head developed and other design features.

While "radial reaction" is negligible at capacities at or close to best efficiency, it can become extremely important at low capacities. Premature shaft failure may occur when centrifugal pumps are operated close to shutoff if the design is not suitable for such operation.

The correct relation of temperature rise at shutoff, including the effect of heat dissipation is:

$$\text{Temperature rise—F per min} = [(\text{bhp at shutoff} \times 42.4) - \text{Heat loss per min}] / [(\text{wt of bare pump} \times C_p) + \text{wt of water in pump}]$$

The heat loss depends upon

¶ temperature difference between the casing walls and the surrounding atmosphere — increasing almost in direct proportion with this difference;

¶ area of the pump casing exposed to radiation and convection — increasing in direct proportion with this area, and

¶ interference with heat transfer —

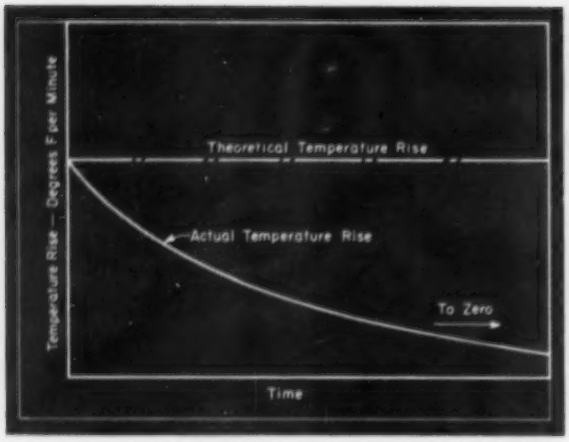


Fig. 3 — Relationship between time and actual temperature rise in centrifugal pump operating with closed discharge valve.

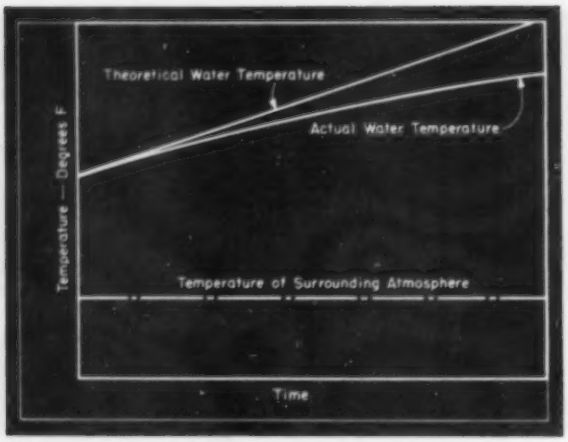


Fig. 4 — Relationship between time and actual water temperature in centrifugal pump operating with closed discharge valve.

such as proximity with building walls, amount of pump casing shielded by baseplate, and so forth.

As a rough approximation, it may be assumed that the rate of radiation from a noninsulated centrifugal pump is 3 Btu per degree F, per square foot, per hour. As an example, let us assume that a given pump consumes 100 brake horsepower at shutoff, that it contains 100 pounds of water, that it weighs 500 pounds, and that its radiating surface is equivalent to 30 square feet. Assume that the temperature of the surrounding atmosphere is 80 F, and that the initial water temperature is 230 F.

If the discharge valve is suddenly closed and we neglect the effect of radiation, the temperature rise per minute at shutoff would be:

$$\frac{(100)\ (42.4)}{100 + (500 \times 0.13)} = 26 \text{ F per min}$$

At the end of two minutes, the water temperature would be 282 F. If, however, the effect of radiation were taken into account, the heat loss, with a 3-Btu rate, would be:

$$\frac{(3)\ (230 - 80)\ (30)}{60}$$

$$= 225 \text{ Btu/min}$$

The actual temperature rise then would be:

$$\frac{(100 \times 42.4) - 225}{100 + (500 \times 0.13)} = 24.3 \text{ F/min}$$

Of course, the actual time required to reach a rate of 24.3 F per minute will be slightly more than the two minutes mentioned because immediately upon an increase in the water temperature, the rate of increase would be slightly less than 24.3 F per minute.

If the temperature of water in the pump and of the pump itself were allowed to increase without any particular regard to boiling point or to mechanical effects on the pump clearances, on stuffing box packing, or on bearing lubrication, then this temperature rise would result in an increase in the rate of heat loss through radiation until it approached the amount of heat liberated through power losses. A state of equilibrium thus would be established. The relationship between time, temperature rise, and actual temperature can thus be expressed qualitatively as in Figs. 3 and 4.

Calculate Equilibrium Temp

To calculate the temperature at which the heat dissipation by radiation would be sufficient to balance the heat added by the power input to the pump, the following formula is used:

Btu input per min = Btu loss by radiation per min.

$$(100)\ (42.4) = \frac{3\ (\text{final temp.} - 80)\ (30)}{60}$$

Final temperature = 2907 F

At that time, theoretically speaking, the water temperature would become stabilized — if there still was any water or any pump left.

It is possible to calculate the time required for the water to reach a temperature of 2907 F, but a rough

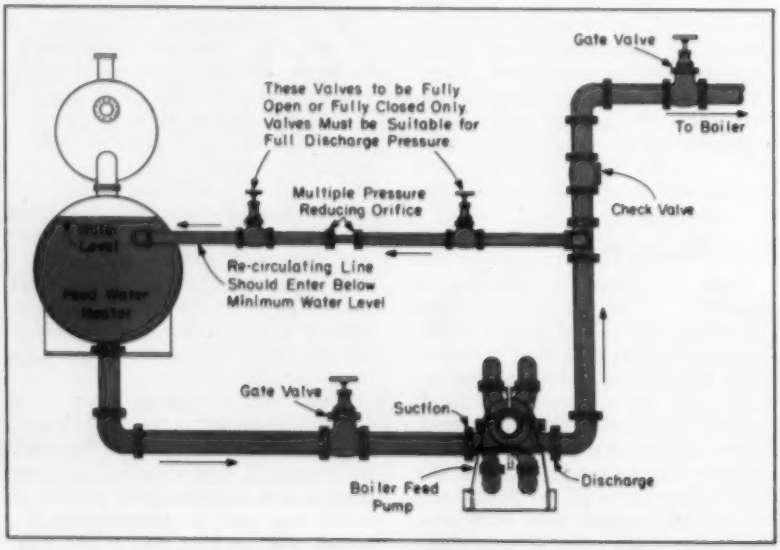

Gate Valve
These Valves to be Fully Open or Fully Closed Only. Valves Must be Suitable for Full Discharge Pressure
To Boiler
Multiple Pressure Reducing Orifice
Check Valve
Water Level
Feed Water Heater
Re-circulating Line Should Enter Below Minimum Water Level
Gate Valve
Suction
Discharge
Boiler Feed Pump

Fig. 5 — Typical boiler feed recirculation arrangement with manually controlled bypass.

estimate is sufficient. The rate of temperature rise starts at 24.3 F per minute and finishes at 0. The average rise therefore is 12.15 F per minute. Starting at an initial temperature of 230 F, the temperature would reach 2907 F in about 220 minutes.

If the amount of heat added to the liquid is small in relation to the pump surface, it can be transmitted through the casing with a low differential in temperature between the liquid and the casing on one hand, and between the casing and the surrounding atmosphere on the other. If the power loss is high and the water content and radiating surface are very low, the liquid temperature will have to reach an exceedingly high value (far in excess of the boiling temperature) before the amount of dissipated heat equals that generated in the pump itself.

Radiation May Be Negligible

Thus, except for very large pumps designed for high capacity and low heads, the heat dissipation through radiation can be neglected. The length of time during which the pump can operate at shutoff must be determined as if no radiation were taking place. The formula to be used in calculating the temperature rise per unit time remains:

Temperature rise —F per min

$$= (\text{bhp at shutoff})\,(42.4) / [\text{wt of bare pump} \times C_p) + \text{wt of water in pump}]$$

A safety factor is desirable in the practical use of this formula. Though the weight of the bare pump is significant, it can be neglected to produce a result on the side of safety. We thereby reduce the formula to:

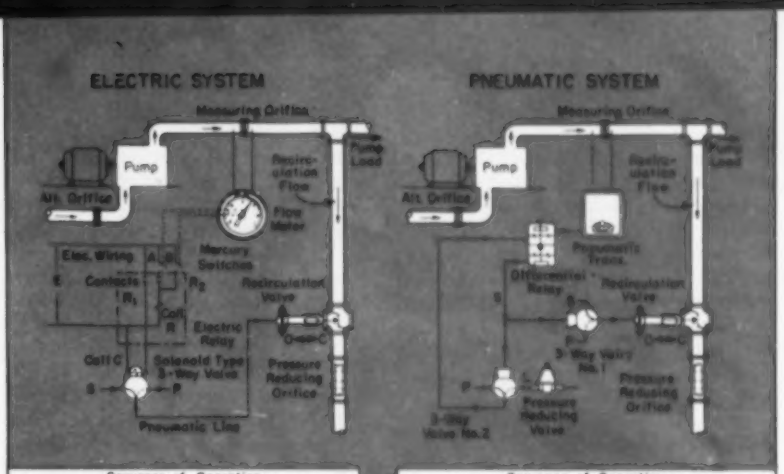
Temperature rise —F per min

$$= \frac{(\text{bhp at shutoff})\ (42.4)}{\text{wt of water in pump}}$$

The brake horsepower can be obtained from performance curves supplied by the pump manufacturer, or it can be computed from power readings in the case of a motor-driven pump. In the case of steam-turbine or gasoline-engine-driven pumps, an on-the-spot determination of brake horsepower values is much more difficult. Unless special test facilities exist, it is definitely recommended that the pump manufacturer be consulted.

Emperical Formulas

Several empirical formulas exist for the determination of centrifugal pump volumes, but their accuracy (even within plus or minus 25 to 50 percent) is doubtful. It is considered best to blank off both suction and discharge flanges, fill the pump completely, drain it, and accurately measure the volume drained.



Sequence of Operation

Seq		At Min Flow	Above Min Flow	Above Min Flow & Below Reset Flow	At Reset Flow
1	Mercury Switch A	O	C	C	C
2	Mercury Switch B	O	C	O	C
3	Relay Coil R	O	C	O	C
4	Relay Contacts R_1 & R_2	O	C	O	C
5	Solenoid Coil C	O	C	O	C
6	Output of 3-Way Valve	P	S	P	S
7	Recirculation Valve	O	C	O	C

S - Supply Air Pressure; C - Closed or Energized
P - Atmospheric Pressure; O - Open or Deenergized

Sequence of Operation

Seq		At Min Flow	Above Min Flow	Above Min Flow & Below Reset Flow	At Reset Flow
1	Relay Output	P	S	P	S
2	Valve 2 Output to Relay	L	P	L	P
3	Valve 1 Output to RC Valve	P	S	P	S
4	Recirculation Valve	O	C	O	C

S - Supply Air Pressure
P - Atmospheric Pressure
L - Reducing Valve Pressure
C - Closed
O - Open

Bailey Meter Co

Fig. 6 — Both pneumatic and electric systems are available for controlling recirculation.

References have been made from time to time to methods of computing the maximum permissible temperature rise in centrifugal pumps that tie the safe temperature rise to the available NPSH (net positive suction head). In such a method, the available NPSH in feet is converted to psi and added to the vapor pressure corresponding to the pumping temperature. The resulting pressure is said to be the vapor pressure corresponding to the temperature to which the liquid may be raised before it will flash.

Such analysis is quite false whenever it is applied to multistage pumps. Only conditions at the first stage need be considered because only the temperature rise in that stage can have an effect on the available NPSH. It is quite obvious that the temperature rise in the first stage equals the total temperature rise divided by the number of stages.

Furthermore, even when applied to single-stage pumps, it is questionable whether the NPSH method has sufficient validity. Assume that the temperature in the discharge passages of the pump reaches a value such that the corresponding vapor pressure is equal to the vapor pressure at the suction plus the NPSH, expressed in psi. It is questionable, then, whether flashing would occur in the liquid bypassed into the suction passages through the wearing ring clearances. After all, this leakage would be immediately diluted with the colder liquid entering the pump in the suction eye of the impeller. The vapor pressure of the combined mixture would be reduced.

So, although the maximum permissible temperature rise cannot be mathematically linked directly to the available NPSH, a number of factors (generally based on experience) enter in establishing this maximum rise. A pump handling very cold water can stand a higher temperature rise than a pump handling liquids at near their boiling points. In the case of boiler feed pumps, the rather empirical value of 15 F maximum temperature rise has been adopted quite widely.

The only means of preventing a temperature rise in excess of some predetermined maximum is to keep the pump from operating below a corresponding minimum flow. But outside influences can cause the complete interruption of flow. It is necessary, therefore, to provide some form of bypass from the pump discharge to a convenient location where the heat picked up by pumping can be dissipated. This bypass should take off between the pump discharge and the check valve. It should never return directly to the pump suction, or the process of picking up heat would be cumulative.

Fig. 5 shows a typical arrangement used on boiler feed pump service. The operation of the bypass as illustrated is manual. The bypass valve is opened whenever there is indication

that the pump flow may be reduced to a dangerously low value. In most high-pressure stations today, the operation of the bypass valve is controlled automatically. The impulse for opening or closing the valve originates at a metering orifice located in the pump suction or discharge.

There are two methods of automatically controlling the recirculation system — pneumatic and electric (Fig. 6). Both systems "trip" at a minimum flow rate, and reset themselves only after actual pump load has increased.

Pneumatic System

The pneumatic flow transmitter supplies one section of differential relay with a signal proportional to pump flow. When flow is normal, this pressure is above that exerted by the relay's loading spring. Relay then applies air to the bellows-operated three-way valves. Three-way valve No. 2 applies atmospheric pressure to a second chamber of the differential relay while valve No. 1 applies full air pressure to the diaphragm of the spring-opening recirculation control valve. This keeps the valve in the closed position since recirculation is unnecessary at this normal flow condition.

When reduced pump flow drives the pneumatic signal from the transmitter below the strength of the spring load of the differential, relay immediately removes air pressure from the three-way valves. Valve No. 1, in turn, removes air pressure from the recirculation valve, permitting it to open. Valve No. 2 supplies an opposing air pressure to the relay so that the transmitted signal must overcome an additional force before the system resets. This prevents "hunting" action.

When pump flow increases, the transmitted signal strength is greater than the combined forces of the spring load and opposing pressure. The differential relay again applies full supply air to the 2 three-way valves. Valve No. 1 permits full air pressure to close the recirculating valve. Valve No. 2 removes the opposing pressure from the relay. This is the steady-state condition.

Electric System

Two mercury switches, A and B, are mounted within and operated by the flow meter. When flow is normal, both switches are closed, causing relay coil R and the solenoid valve coil C to be energized. The three-way solenoid-operated valve applies full air pressure to the spring-opening recirculation valve. This keeps the valve in the closed position since recirculation is unnecessary at this normal flow condition.

Under decreasing flow conditions, switch B opens first. When switch A opens at minimum flow, coil R is deenergized, opening its contacts. Coil C then is deenergized and the three-way valve removes supply air from the recirculation valve, permitting it to open. Since switch B is open, the flow must rise to a higher value before the system resets. This prevents "hunting" action.

Switch A will close as a result of the increased flow caused by the open recirculation valve. When the pump flow increases further as a result of actual demand increase, however, switch B will also close. Coil R becomes energized, closing its contacts. Contact R_2 is a holding contact, preventing the system from "tripping" even though the flow may fall slightly. Solenoid coil C will again become energized through contact R_1. The three-way valve then permits full supply air pressure to close the recirculation valve. This is the steady-state condition.

To limit the flow through the bypass to the value dictated by the chosen maximum temperature rise, an orifice is located in the bypass and should be sized to pass 30 gpm for each 100 hp at shutoff conditions.

In brief . . .

ASME Spring Meeting

THE ASME held its Spring Meeting in Baltimore, Maryland April 18 to 21. It was part of the yearlong celebration of ASME's 75th anniversary. About 1000 engineers came. Eighty-one papers were scheduled in seven sessions.

Chemistry in the Power Plant?

Frank U. Neat, senior engineer
Consolidated Gas Electric Light & Power Co. of Baltimore

"The art of feedwater and boiler water chemistry can be divided into three classes. The first class believes that if water can be made pure enough, and kept pure, it is suitable feedwater. The second class believes that it is not worth the effort to produce such pure water; that keeping the water pure is beyond the realm of practicality; that pure water alone will dissolve iron and other metals and this class treats the water with chemicals to render the impurities innocuous and to reduce the ability of the water to dissolve metals. A third class is always hoping that someone will come along with a gadget which will cure all difficulties of the handling of water and production of steam from this water.

"One of the prime reasons why power station chemistry is misunderstood is that, when a paper is written propounding the benefits of any one chemical or system of chemicals in the power plant, while the truth may be told it is seldom that the whole truth is told. In some cases, this may be because the whole truth is not known. In other cases the whole truth is not told for publication but is conferred in confidence or in private. In either case, a false impression is given to those who are not versed in the chemical arts. For instance, those of us who chemically treat do not make widely known our troubles with hideout, sampling, and testing. Nor do we admit to harmful chemical breakdown. On the other hand, those who practice no treatment do not make widely known their difficulties with tube failures or do they treat the ammonia content of their steam as of any great importance."

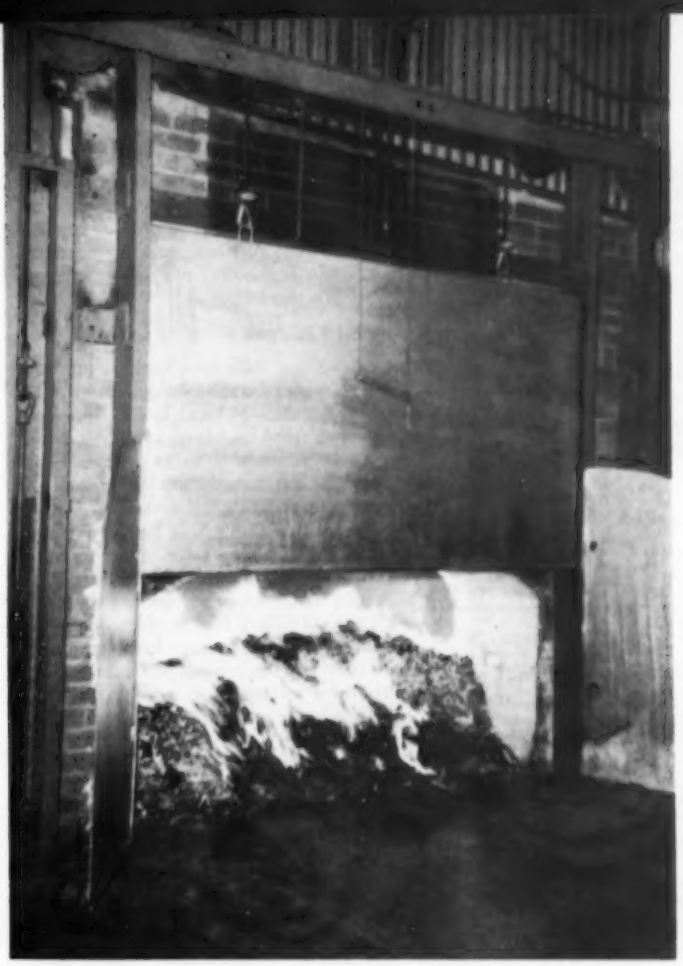
Slime in Cooling Towers

R. S. Wise, Technical Service
National Aluminate Corporation

Wise points out that information published over the past 22 years is rare on the problem of corrosion resulting from bacteria growth in cooling-tower systems. His paper outlines the ways in which bacterial corrosion can take place in cooling-tower systems, and presents data developed under laboratory controlled conditions to illustrate the degree of corrosion that may be expected. The total corrosion rate in the presence of slime may easily be double that in the absence of slime, as indicated by the laboratory tests.

Interpreting his results, Wise reports "The data presented show a definite adverse effect on corrosion rates of steel by the presence of microbiological growth. The degree

(continued on page 62)



Loading side of incinerator shows brightness of interior brickwork — sure sign that furnace is operating at high temperature and is incinerating. Incandescent brickwork is best catalyst for complete secondary combustion.

I&P EXCLUSIVE

Will It Pay To Incinerate Your Wastes?

R. L. WELLSTEAD, Brule Incinerators, Chicago

TABLE I—BREAKDOWN OF WASTE FROM COMPOSITE PLANT

Source	Nature	Percent of Total By Weight	By Volume
Office	Loose paper	6%	12%
Office	Files, catalogues, dense papers	8	2
Plant	Loose paper	3	7
Plant	Wood, skids, timbers	8	2
Plant	Misc. paper, cartons, boxes	20	25
Maint.	Wood scraps, shavings	8	3
Maint.	Sawdust	9	4
Shipping	Paper, boxes, packing residues	3	7
Receiving	Cartons, packings, boxes, barrels	12	13
Employees	Newspaper, packages	4	4
First Aid	Paper, bandages	2	1
Wash rooms	Damp paper	6	6
Lunch area	Wax paper, food residues	2	9
General	Floor Sweepings	6	3
Miscellaneous	Including those unaccounted for	3	2
		100%	100%

WASTE DISPOSAL can be based on sound economic considerations. Too often, though, it is thought out when the plant is new — and afterwards ignored. Seasonal variations in salvage prices and in the cost of dumping combine to complicate the picture, making any continuing analysis difficult.

A waste disposal survey of your plant may show many economies that can be made. Table I shows the composite results of surveys conducted in 55 plants, with the percentages of wastes (by weight and volume) tabulated against the departments where the wastes originated. Table II indicates the average weight of common factory wastes.

Table III gives the results of surveys in 25 plants, showing unusual process wastes in relation to the overall waste picture. It gives an in-

TABLE II—WEIGHT OF COMMON WASTES

Nature of Waste	lbs/cu ft
Garbage, usual run	50
Garbage, 75% moisture	47
Garbage, 65% moisture	45
Rubbish, usual run	12
Rubbish, 15% moisture	5 to 10
Rubbish, office	7
Paper, dense	7.5
Paper, loose	3 to 7
Sawdust	11 to 20
Shavings	3 to 10
Wood, dry	12 to 15
Sludge (oil and water)	60
Oil, lubricating	57

dication of the waste disposal methods particularly suitable for these plants. For example, the four metalworking plants with floor sweepings should consider dumping their wastes in open dumps or in sanitary fills. The sanitary fill method involves cutting a hole in the dump area, loading in the wastes, compacting with heavy equipment to reduce the volume, and covering with a layer of earth at least three feet thick. The cost of the necessary equipment and its maintenance plus that of the skilled labor required limits this method to large factories and municipalities. The system, however, does make the dump comparatively attractive, and the filled land can often be used at a future date for other purposes.

Dangers of Dumping

Spray booth residues, as cited in Table III, can be dumped. This may not be permitted, however, because surface waters may be contaminated, or because the residues may spontaneously ignite or detonate after partial decomposition. These wastes can be burned. Incineration is the preferable method.

Sawdust wastes are usually collected in a cyclone and burned in an incinerator. Where there is a process need for heat, the incinerator may be designed for heat recovery. A special waste-heat furnace may be used or an ordinary boiler may be modified to burn the sawdust.

Food Residues

Residues from food processing may be dumped, but this is not often possible because of local laws. They can be sold, used as a byproduct, or dried for other usage. Thanks to state laws prohibiting inter-state shipment of garbage-fed hogs, disposal of waste food to hog feeders is becoming uncommon. Food wastes may be pulverized by waste food grinders, but again this depends on local laws. Since auxiliary fuel is often economically available to burn large amounts of food wastes, incineration is the best method to use.

It is interesting that cafeteria waste usually runs about one pound per meal and consists of 40 percent garbage that has a 75 percent moisture content. On the other hand, lunchroom waste runs about ¼ pound per meal and consists of 10 percent garbage that has a 75 percent moisture content. The surprising thing about cafeteria wastes is the great volume of the combustible portion such as butcher paper, food cartons, and pasteboard boxes. Since these are all more or less contaminated with decomposable food residues, burning is the preferable method of disposal.

Plastic scrap and sawdust are somewhat like paint residues — dumping is probably the better method. But these wastes may eventually decompose and pollute surface waters, spontaneously ignite, or explode after burial. Burning in an open dump gives off objectionable smoke and odor. Incineration is again often required here.

Office and plant wastes are best burned, since they may contain confidential information. If sold, they require baling and sorting to remove blueprints, carbon paper, and typewriter ribbons. Some office files, catalogs, and dense paper can be sold with a minimum of sorting. This is perhaps worthwhile. The wastes from wash rooms, lunch areas, and first aid stations are best burned. Cartons, if not reusable, should be compacted and sold, or burned. Dumping is not very practical because of the large volume-to-weight ratio of these wastes. Floor sweepings can be dumped, but they will usually burn easily enough.

Most Wastes Burned

There are probably more wastes destroyed by burning than by all other methods combined. Of the 55 plants surveyed in connection with Table I, over 56 percent burned their wastes. The next largest group, 25 percent, used scavenger service. The methods of waste disposal in the 55 plants at the time of the survey is fully tabulated in Table IV.

Bonfire burning in pits, dumps, waste burners, and wire or metal enclosures is the most economical method from an equipment investment point of view. The burning area can be any level spot that is a safe distance from the plant. It should be enclosed by some type of fence or shelter to keep papers from blowing around. Operation is simple and access ports are usually immense so that charging can be done easily.

Dangers of Burning

The disadvantages of open burning, however, are numerous. A large proportion of city fire alarms are in response to bonfires that get out of control even though they are at a safe distance from the plant and neighbors. The burning area is usually an eyesore. Smoke, odors, soot, and fly ash may seriously inconvenience the plant and its neighbors. Flying embers are a source of danger. Safety requires that an attendant stay near the fire, so operating costs are high. The remote location

TABLE III—UNUSUAL WASTES

Plants Surveyed	Nature of Waste	Percent Total Plant Waste By Weight	Percent Total Plant Waste By Volume
Four metalworking plants	Non-combustible floor sweepings	40	10
Five appliance-automobile plants	Paint spray booth residues	15	2
Three fabrication plants	Varnish and plastic sawdust	6	3
	Sawdust and wood trimmings	15	5
Six food processing plants	Food residues	40	10
Four plastic fabrication plants	Plastic scraps, injection trimmings	36	12
Three packaging plants	Broken packages, spillage, samples	10	30

TABLE IV—EXISTING METHOD OF WASTE DISPOSAL FOR 55 PLANTS

Burning	
Adequate incinerator	1
Improper incinerator	2
Waste burners, bonfires	15
Boilers, under steam	1
Boilers, disconnected	3
Boilers, heat recovery	1
Dumps, with purposeful ignition	6
Dumps, without purposeful ignition	2
Scavenger Service	
Outside contractor	13
Salvage	
Baling for sale	6
Unbaled, for sale in crates (essentially free pickup)	1
Partial Baling	
Cardboard for incineration	2
Cardboard, paper for scavenger	1
Paper, cardboard for dump	1

increases hauling and handling costs. (In general, the biggest cost in waste disposal programs is in transporting the wastes from their point of origin to the disposal points). Incineration is the only burning method that is free from these problems.

Where coal-fired boilers are used, wastes are often burned on the fuel beds even with stoker-fed systems. If the wastes are not large, this eliminates additional equipment and manpower. However, furnaces built to burn a uniform fuel efficiently do not operate properly with nonuniform waste fuels. The soot and ash from the wastes coat the heating surfaces and probably decrease heating efficiency more than enough to offset any heat release advantage. Where there are dense combustibles, as in saw mills, there are specially designed furnaces that will efficiently burn these wastes.

If wastes are to be burned, dry wastes (up to 30 percent moisture, by weight) can be expected to release about 7000 Btu per pound. Wet wastes (up to 75 percent moisture, by weight) release about 4000 Btu per pound. Ash from wastes runs about 1 percent (by weight) for trash and 2 percent for foods.

Special Furnace

An incinerator is a special firebrick-lined furnace designed to safely, continuously, and unobtrusively burn a wide variety of wastes. It is, in effect, a special type of furnace. The grate is heavier to withstand the hotter firing chamber temperatures and hotter ash. It is designed so that the fire will not be smothered by subsequent charges.

Incinerators eliminate smoke, soot, and odors. The outgoing gases are burned clean by mixing a generous amount of secondary combustion air with the gas stream after it has left the firebed, by spinning the gases against the incandescent refractory walls, and often by passing them through a series of chambers lined with incandescent refractory.

The incinerator furnace is completely lined with firebrick and is usually faced with masonry. Missouri clay makes a brick that is most resistant to spalling (cracking and chipping) under the widely varying temperatures encountered in incineration. Sometimes auxiliary fuel such as oil, gas, coal, wood, or residues (liquid or gas) are used to warm up the incinerator, or to keep it up to temperature.

Smaller units, 200-500 pounds per hour, come as packaged furnaces.

Economics of Incineration

Incinerators are expensive. Their cost, however, is usually recovered quickly from reduced disposal costs. Annual maintenance runs two to five percent of the initial incinerator cost. The two-percent figure is common except under very careless operation. Incinerators can be continuously charged as fast as the load burns down. They reduce wastes to a very small amount of sterile ash that presents few problems for final disposal.

Central incinerator, in scattered plant, is outside charging building so maximum space is available for storing and loading. Non-combustibles are pushed to rear access doors.

ASME Spring Meeting

. . . starts on page 58

of increase and corrosion may vary from 25 to 100 percent according to these data. There is a possibility that even greater increases in corrosion rates due to microbiological growth could be obtained where mineral corrosion inhibitor is inadequate. Because of the localized attachment of slime growths, it is very probable that localized attack of steel can be expected with microbiological growth.

"The degree of corrosion to be expected from this source certainly justifies good control of bacteria in a cooling-tower system from the standpoint of corrosion alone even if there were no other adverse consequences of the microbiological growth such as reduced heat transfer, restriction of water flow, etc."

Westinghouse Electrification Forum

Information of great interest to power services engineers was presented at the recent 19th Annual Machine Tool Electrification Forum sponsored by the Westinghouse Electric Corporation.

Cycling the Rerate Motor

R. F. Woll, design engineer
Westinghouse Electric Corporation

"There have been many presentations justifying the NEFA rerate program and stressing the benefits it has to offer to both users and manufacturers. Most of these presentations have cited the advances in magnetic and insulation materials development and processes. They have told how these advances are translated into user benefits, by supplying the same power in a smaller package. Emphasis has been placed on the fact that NEMA performance standards are unchanged. Rerate motors, rating for rating, have the same torque, locked current, slip temperature rise, and service factor standards as the old motors.

"All this is rather convincing proof that rerate motors will fill the requirements of normal applications such as fans, pumps, compressors, or drills. But many machine tool applications are of a different nature, and the question arises: 'How will rerate motors serve duty cycle drives?' The answer in brief: Rerate motors will serve duty cycle applications, and serve them well . . .

"The rerate motor has a thermal capacity equal to or greater than the old motor. In the final analysis, thermal capacity makes or breaks a motor for duty cycle drives. On this basis, the standard rerate motor will be superior on those machine tool applications where standard motors are customarily applied. And on the severe duty cycle drives that require special motors, the improved thermal capacity of the rerate motor will be even more of (a) benefit."

Use Wye-delta Starting

Kendall H. Spencer, electrical engineer
Blanchard Machine Company

"Starting with the basic requirements of current limitation, we reexamined the various methods of obtaining reduced current starting. Primary resistance was tentatively eliminated because of the size of the resistance enclosure. Auto-transformer starting was considered, but, again, extra space would be required. Part-winding starting was rejected because, although it satisfied increment allowances, it proved in tests to be unsatisfactory in meeting maximum current limitations. Wye-delta control remained, but it was not in common usage in this country. In spite of this possible disadvantage, wye-delta seemed to be the most desirable control, if it could proved to cost no more than any other method.

"When one considers that the product has been materially improved by . . . eliminating troublesome resistors, the change to wye-delta starting is definitely one of desirable progress."

Reducing Radio Interference

C. D. Fahrnkopf, radio interference laboratory
Westinghouse Electric Corporation

"The principles used in the reduction of radiated interference are essentially the shielding of all sources which cannot be eliminated and grounding of anything that might become an antenna. Here are four specific rules to follow:

"(1) All cover plates should be of metal and bonded to the body of machine tool. Cover plates can be bolted down with bolts spaced not more than three inches apart. Metal mesh gaskets should be used instead of cork or rubber or other types of insulating gaskets. Door-type covers should have contact fingers all around the edge or woven metal gaskets bolted or spot welded to the door or door frame. The metal gasket mating surfaces should not be painted. They should be electrically conducting.

"(2) All leads external to the machine tool should be in conduit or in all-metal hose if flexibility is required. The conduit or other shield should be bonded to the housing right at the entrance or exit point. Ordinary flexible armored cable sheath is not a suitable shield for wiring. All-metal flexible tubing, such as used for piping liquids at machine tools, is a good shield for wiring.

"(3) Run all oil or air pipes which are metal against the machine frame. To make good electrical contact, be sure pipe and machine frame make solid contact every two or three feet. Any metal piping which goes inside machine should be bonded at the entrance point.

"(4) To prevent belt static, use conducting or anti-static belts."

Fahrnkopf went into further detail about reducing conducted interference and about specific recommendations "which will help to reduce costs by making the most efficient use of filters."

Meet the Cypak System

R. A. Ramey, materials engineering department
Westinghouse Electric Corporation

"Cypak systems are static switching circuits developed by Westinghouse for industrial control applications. They are not direct replacements for relays on a one-for-one basis; they are intended as replacements for relay systems.

"These functions (of Cypak systems) may be thought of as building blocks that can be combined in a variety of ways to establish a desired relationship between the information that is fed into the control system, and that which is taken out."

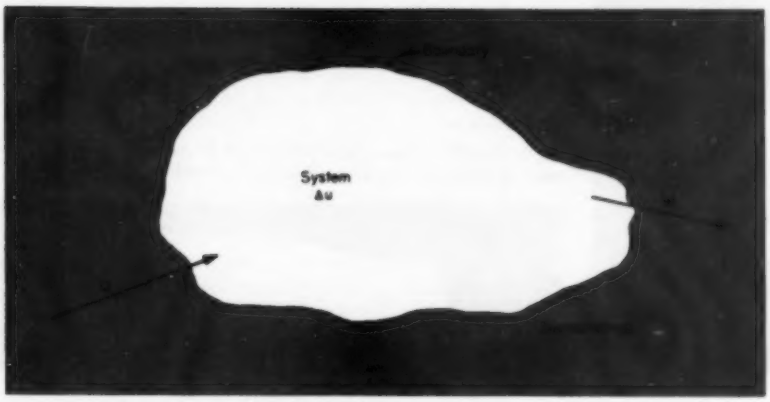


Fig. 1 — Fixed non-flow system with both heat and work crossing the system boundary.

A Thermodynamics Refresher - II

The First Two Thermodynamic Laws

JOHN F. LEE
Professor of Mechanical Engineering
North Carolina State College

I&P EXCLUSIVE

INDUSTRY & POWER continues its Refresher Series. Renew your understanding of the basic concepts that form the basis for many of industry's power services. Additional single copies are available to you gratis.

THE FIRST LAW of Thermodynamics states that energy may be neither created nor destroyed. If energy disappears in one form it must reappear in another because it cannot disappear altogether. Nor can any energy appear in one form without a corresponding decrease of energy in other forms because energy cannot be created. The First Law is a relentless bookkeeper, requiring a strict accounting for energy in all its forms.

In order to apply the First Law to a system where there is no flow across the system boundaries, the system itself will be considered to be fixed as to position. Chemical reactions will be excluded. Under these conditions we thereby exclude kinetic, potential, and chemical energy from consideration.

Fig. 1 represents such a system, where heat and work cross the system boundary. The heat transferred to the system must be equal to the sum of the change in internal energy and the work, in accordance with First Law. We can thus say that $Q = \triangle U + \frac{W}{J}$ where the heat *added to* the system is positive and work done *by* the system is positive. This equation also may be written for a system consisting of one pound of substance. The equation then takes the form $q = \triangle u + \frac{w}{J}$ Note that the conversion factor, $J = 778$ ft-lb/Btu, has been introduced so that all terms of the equation are expressed in Btu.

The open system in Fig. 2 represents a device through which a fluid flows. Heat is supplied to the system and work is done by the system. The amounts of heat and work crossing the boundary of the system are constant with time. The mass of fluid entering at Point 1 is constant per unit time, and is equal to that leaving at Point 2. The pressure, temperature, specific volume, and velocity do not vary with time at any point in the flow path. We account for the different forms of energy entering the system as:

$$\text{Kinetic energy} = \frac{MV_1^2}{2gJ} \text{(Btu per sec)}$$

$$\text{Potential energy} = \frac{Mz_1}{J} \text{(Btu per sec)}$$

$$\text{Internal energy} = Mu_1 \text{ (Btu per sec)}$$

$$\text{Flow energy} = \frac{Mp_1v_1}{J} \text{(Btu per sec)}$$

$$\text{Work done } by \text{ the system} = Mq \text{ (Btu per sec)}$$

M is the flow in lb/sec. Similar expressions may be written for the energy leaving the system. The weight of fluid and energy entering the system are constant with time, and are equal to the weight of fluid and energy leaving the system. In other words, "what goes in must come out at the same rate." The energy balance is written mathematically as

$$\frac{MV_1^2}{2gJ} + \frac{Mz_1}{J} + Mu_1 + \frac{Mp_1v_1}{J} + Mq = \frac{M_2V_2^2}{2gJ} + \frac{M_2z_2}{J} + M_2u_2 + \frac{M_2p_2v_2}{J} + \frac{Mw}{J} \quad (6)$$

For a flow of 1 lb per sec, Eq. (6) may be expressed

$$\frac{V_1^2}{2gJ} + \frac{z_1}{J} + u_1 + \frac{p_1v_1}{J} + q = \frac{V_2^2}{2gJ} + \frac{z_2}{J} + u_2 + \frac{p_2v_2}{J} + \frac{w}{J} \quad (7)$$

Furthermore $(u + \frac{pv}{J})$ is enthalpy and may be represented by h and

$$\frac{V_1^2}{2gJ} + \frac{z_1}{J} + h_1 + q = \frac{V_2^2}{2gJ} + \frac{z_2}{J} + h_2 + \frac{w}{J} \quad (8)$$

Equations (6), (7), and (8) are forms of the *steady-flow energy equation.*

Equation of Continuity

If the law of conservation of mass is applied to steady flow, we can derive an equation relating the mass-flow rate at different points in the path of flow. An example of steady flow is the flow of a fluid in a pipe as shown schematically in Fig. 3. For the condition of steady flow

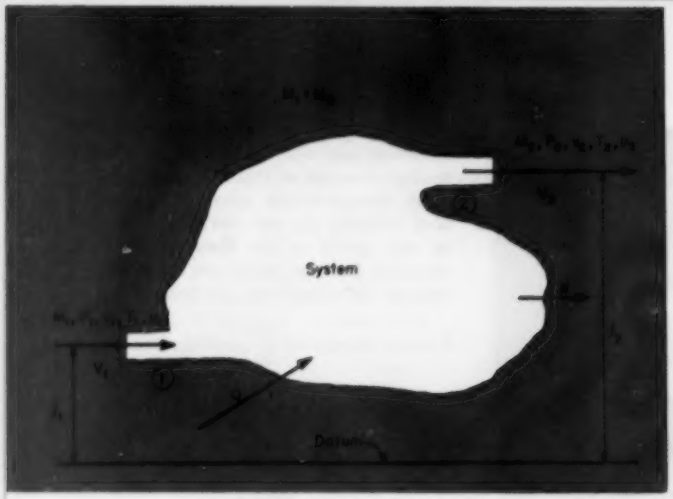
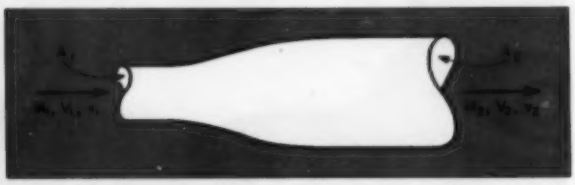


Fig. 2 (left) — Mass of fluid flowing in open system is constant with time. Heat is supplied to system and work done by system.

Fig. 3 (below) — Using pipe as example of system, mass-flow rate entering pipe must equal that leaving for condition of steady flow.



the mass-flow rate entering the pipe must equal that leaving, or

$$M_1 = M_2 \qquad (9)$$

The volume-rate of flow is given by the product of the cross-sectional area A and the velocity V. If the volume-rate of flow is divided by the specific volume we have the mass-flow rate. Hence, entering the pipe we have

$$M_1 = \frac{A_1 V_1}{v_1}$$

and leaving

$$M_2 = \frac{A_2 V_2}{v_2}$$

Combining the above two equations with Eq. (9) we may write

$$M = \frac{A_1 V_1}{v_1} = \frac{A_2 V_2}{v_2} \qquad (10)$$

which is called the equation of continuity for steady flow.

Reversibility and the Second Law

The First Law states that energy is conserved and implies that the different forms of energy are mutually convertible. But the First Law alone is inadequate because experience tells us that certain energy transformations are either impossible or restricted.

Suppose that two blocks at different temperatures, constituting a completely isolated system, are brought in contact. Heat will flow from the hotter block to the colder one. Eventually the two blocks will come to the same temperature. No more heat will flow. The system is then said to be in equilibrium and the internal energies of the two blocks are equal.

The internal energy of this system, however, has not changed. A significant feature of this process is that it occurred spontaneously — there was no assistance from the surroundings since the systems were isolated. Would it be possible for this process to reverse itself spontaneously so that the initial state of the system was restored? Nothing in the First Law forbids such a reversed process.

To reverse the process, though, one block would have to become cooler and the other warmer. Heat would have to flow from the colder to the hotter block, until the original temperatures were reached. We can reject this event as impossible in the light of common experience. Clearly, the process is *irreversible* in the thermodynamic sense. Of course, it would be possible to cool one of the blocks and heat the other so that the original temperatures could be restored, but this would require a transfer of energy between the system and its surroundings.

What have we lost by permitting an irreversible process? Certainly, energy has not been lost since this would violate the First Law. What we have lost is *opportunity*. The heat flow between the two blocks could have been used to generate steam that in turn could have done work. This opportunity was lost. How then can we know which directions are possible for certain processes or if a certain process is possible at all? The answer to these questions must be sought from the Second Law.

The Second Law of Thermodynamics states that no system can receive heat at a given temperature and reject it at a higher temperature without receiving work from the surroundings. To explore this further, let's discuss cycles.

Defining Cycles

A *cycle* is defined as a process, or sequence of processes, which periodically returns a system to its original state. A *reversible cycle* is one in which the processes are all reversible in the thermodynamic sense. Where temperature differences or friction are involved, the process is necessarily irreversible. Suppose that heat is transferred from a *source*, such as the sun, that has an infinite capacity to transmit heat without temperature change. Then suppose another body has an infinite capacity to absorb heat without temperature change, that it is at a slightly lower temperature than the source, and that it receives heat from the source at this temperature. Obviously the two bodies will never reach temperature equilibrium. Since the temperature difference between the two bodies is very small, the degree of irreversibility is very small. If two streams of fluid exchange heat in counterflow so that the temperature difference between the streams is always small we again approach reversibility (which is to say irreversibility is minimized).

Meet Carnot Cycle

The Carnot cycle is a reversible cycle consisting of four processes. In this cycle, the system takes in heat at constant temperature from a constant-temperature source that is at an infinitesimally higher temperature than the system. This pro-

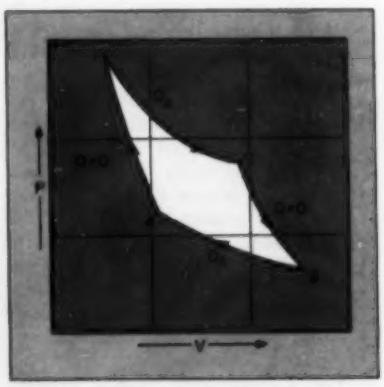


Fig. 4 — Carnot cycle with a gas as system (say in a cylinder) shown on a P-V diagram.

cess requires that the source and system be heat reservoirs of infinite capacity. The second process is a reversible adiabatic expansion (no heat transfer) in which work is done by the system without friction. The third process consists of a reversible constant-temperature rejection of heat. This process requires that the system behave as an infinite heat reservoir and assumes the availability of an infinite heat sink to receive the rejected heat. The fourth process is a reversible adiabatic compression in which work is done on the system without friction. The working substance that constitutes the system experiencing the Carnot cycle may be a gas, liquid, solid, or a two-phase mixture.

Fig. 4 shows a Carnot cycle on a P-V diagram when the system consists of a gas enclosed by a boundary consisting of a cylinder with a frictionless piston. The piston and cylinder, excepting the cylinder head, are thermally insulated from the surroundings.

First, the cylinder head is placed in contact with an infinite heat reservoir located in the surroundings (whose temperature is T_A as shown in Fig. 5). Heat flows from the heat reservoir to the system, which remains at constant temperature ($T_1 = T_2$) during the process depicted by the curve 1-2 in Fig. 4. The temperature T_A is infinitesimally higher than the temperature $T_1 = T_2$.

Volume, Pressure Changes

Notice that the specific volume of the system increases and the pressure decreases during the process 1-2. The piston moves up and expansion work is done by the system.

Next, the cylinder head is placed on a perfect thermal insulator. The process 2-3 then ensues with a further increase in specific volume and a decrease in pressure and temperature. The process is reversible and adiabatic since the system is thermally insulated and the piston movement is frictionless. Again the piston moves up and expansion work is done by the system.

Now the cylinder head is placed in contact with an infinite heat sink at the constant temperature T_R. Heat is rejected in the process 3-4 from the system to the sink at the constant temperature $T_3 = T_4$, which is infinitesimally higher than T_R. In this process the pressure increases, the specific volume decreases, the piston moves down, and compression work is done on the system by the surroundings.

In the final process 4-1, the cylinder head is again placed on the thermal insulator. A reversible adiabatic compression takes place in which work is done on the system by the surroundings. The result is that the pressure and temperature both increase and the specific volume decreases. It is important to note that the system is returned to its original state (Point 1) in the P-V diagram of Fig. 4 at the end of each complete cycle.

Citing the First Law

From the First Law, for the cyclic process we can write (since the net change in internal energy is zero)

$$\Delta U = Q - W = 0$$

where Q_A = heat transferred into system,

Q_R = heat rejected from system

But Q is the net amount of heat transferred to the system, or $Q_A - Q_R$. From the preceding energy equation, then, the net useful work done by the system is

$$W = Q_A - Q_R$$

Now the *thermal efficiency* of a heat engine is defined as the ratio of the net useful work done to the heat added in a cycle, or

$$\text{eff}_{th} = \frac{W}{Q_A} = \frac{Q_A - Q_R}{Q_A} \qquad (11)$$

Only a portion of the heat added in a cycle can be converted to useful work. Otherwise an infinite amount of heat would have to be added, or no heat would be left to be rejected. Both these conditions can be summarily rejected as impossible. However, a more useful argument can be made after introducing the concept of entropy.

Here Is Entropy

We can define a *change of entropy*, ds, for a reversible process as

$$ds = \frac{dQ}{T} \qquad (12)$$

Values of entropy relative to some datum state of the system thus may be computed and tabulated. Entropy may be then treated as a property that is independent of the nature of the process, and that may be related to other properties such as pressure and temperature. We can compute the change in entropy for an irreversible process by the simple expedient of substituting a hypothetical reversible process between the end states of the real process. The change in entropy, like the change in internal energy, *is a function of the end states only* and will have the same value for all processes that may take place between these end states.

What is the significance of entropy? To answer this question, we first compute the change in entropy for a few important processes. For the reversible constant-temperature processes of the Carnot cycle, the change in entropy can be easily calculated by means of Eq. (12) since the temperature is constant. For processes in which the tempera-

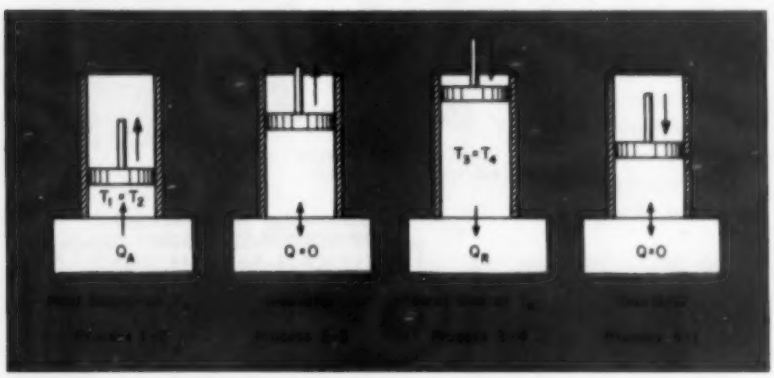


Fig. 5 — Carnot heat engine consisting of gas in a cylinder with frictionless piston. Cylinder head can be moved from infinite heat source to perfect insulator or infinite sink without heat loss.

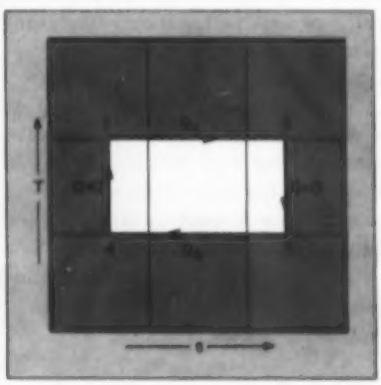


Fig. 6 — Carnot cycle on T-S diagram, shows the two isentropic processes in cycle.

ture changes we have the equation

$$S_2 - S_1 = c_p \ln \frac{T_2}{T_1}$$

when the pressure is constant and

$$S_2 - S_1 = c_v \ln \frac{T_2}{T_1}$$

when the volume is constant. The reversible adiabatic process deserves special attention. For this process, the change in entropy is zero.

Now let us return to the Carnot cycle where heat was added and rejected in the cycle by means of reversible constant-temperature processes. Hence we may substitute Eq. (12) in Eq. (11) to get the thermal efficiency of a heat engine. For the Carnot cycle we get

$$\text{eff}_{th} = \frac{Q_A - Q_R}{Q_A}$$

$$= \frac{T_A \Delta S_{1\text{-}2} - T_R \Delta S_{2\text{-}4}}{T_A \Delta S_{1\text{-}2}}$$

But (see Fig. 6) processes 2-3 and 4-1 are isentropic (entropy is constant), so that $S_2 = S_3$ and $S_1 = S_4$. Therefore $\Delta S_{1\text{-}2} = \Delta S_{2\text{-}4}$ and

$$\text{eff}_{th} = \frac{T_A - T_R}{T_A}$$

This expression shows clearly that the thermal efficiency of a Carnot cycle depends on the temperatures at which heat is added and rejected.

In order to attain a thermal efficiency of 100 percent it would be necessary to have a constant-temperature source with an infinitely high temperature or a constant-temperature sink at the absolute zero temperature. Such a source and sink do not exist in nature, and we must be satisfied with a thermal efficiency of less than 100 percent. The Carnot cycle is completely reversible, however, and no opportunities are lost to convert heat into work—so it is the best we can do.

Let us now return to the irreversible process in which heat was transferred from one block to another. Suppose we had interposed a Carnot cycle between the two blocks. Then we would have taken advantage of the opportunity to convert a portion of the heat into work—the portion being the thermal efficiency times the quantity of heat transferred. If we had used a Carnot cycle the thermal efficiency would be

$$\text{eff}_{th} = 1 - \frac{T_R}{T_A} = 1 - \frac{Q_R}{Q_A}$$

from which we get

$$\frac{T_R}{T_A} = \frac{Q_R}{Q_A}$$

$$\text{or } \frac{Q_A}{T_A} - \frac{Q_R}{T_R} = 0$$

But Q_A/T_A and Q_R/T_R are the changes in entropy for each of the blocks. We note from the preceding equation that the entropy of the hotter block is decreased by an amount equal to the increase in the entropy of the colder block. The entropy of the system, consisting of the two blocks, is unchanged. In the actual irreversible process, where a Carnot cycle was not used, the heat transferred from the hotter block Q_A equals that received by the colder block in accordance with the First Law. But $T_A > T_R$, and so

$$\frac{Q_R}{T_R} > \frac{Q_A}{T_A}$$

In other words, the increase in the entropy of the colder block is greater than the decrease in the entropy of the hotter block, and the entropy of the system increases. Could the entropy decrease? Not unless T_R were greater than T_A, which would mean heat would have to flow from the colder block to the hotter block. We know this is impossible.

From the discussions of the Carnot cycle and entropy, we are in a position to formulate another concise and intelligible statement of the Second Law. The most fundamental statement is: *The entropy of an isolated system cannot decrease but must increase or remain constant.*

Next Month: Another article in INDUSTRY & POWER'S Thermodynamics Refresher. Prof. Lee will write about "Steam Power Cycle Relationships."

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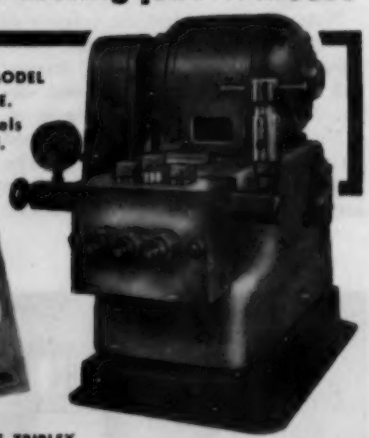

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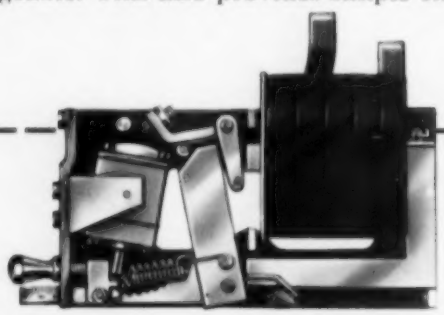
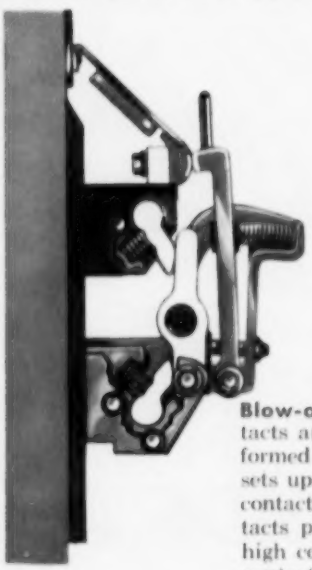
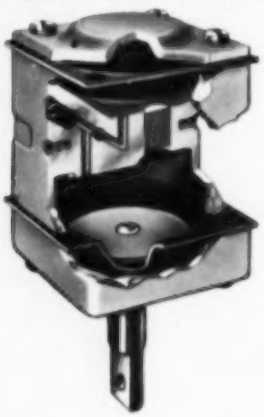
✓ Long contact life — "blow-on" action, plus positive wiping motion, reduces contact erosion.

✓ Interchangeable — trip devices of various ratings are easily interchangeable. This also provides simple change of current ratings.





Positive Displacement Trip Device—Adjustable calibrations on front of trip device permit operator to adjust and set long-time, short-time or instantaneous elements independently. Series trip coils are completely insulated.



Blow-on Contacts—When contacts are closed, current in loop formed by studs and movable arm sets up magnetic forces pushing contacts together. After main contacts part, blow-on action holds high contact pressure on arcing contacts. On closing, blow-on action helps increase contact pressure — opposes bounce.

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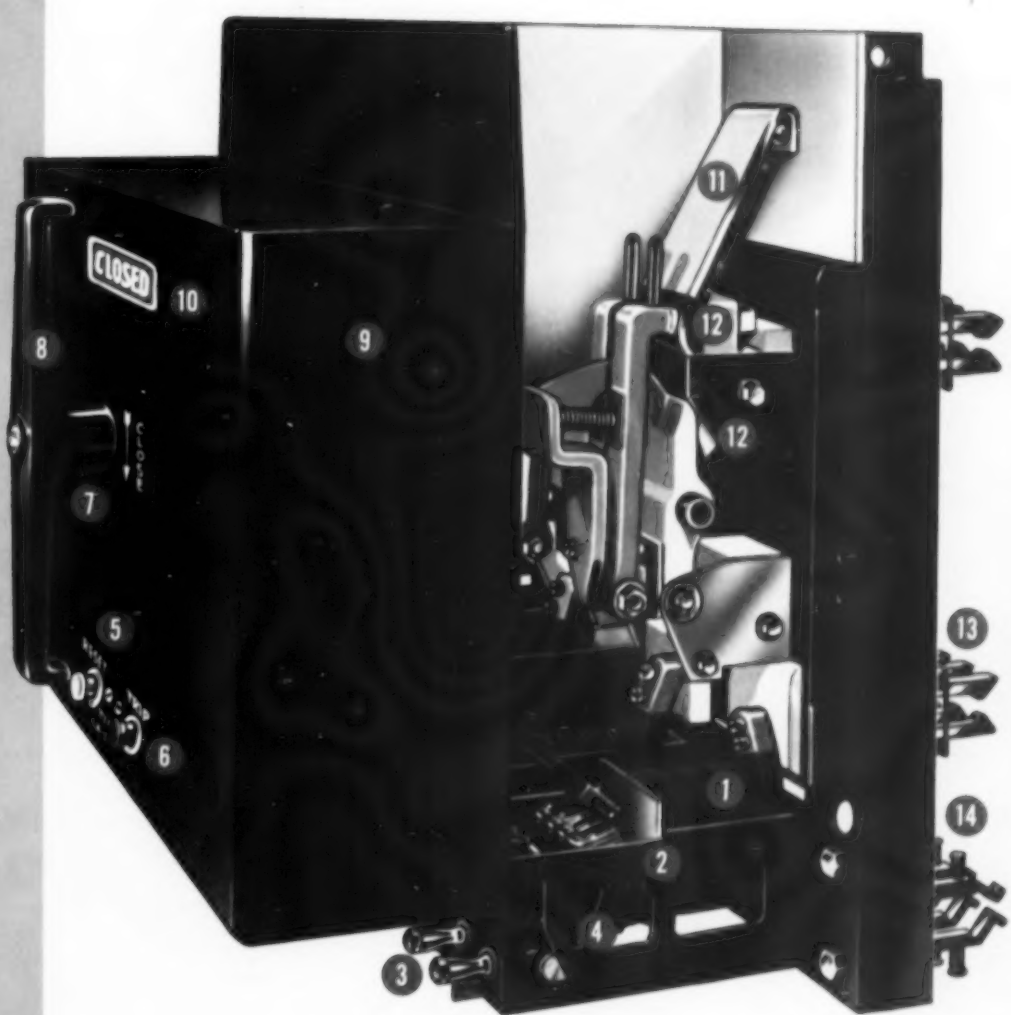
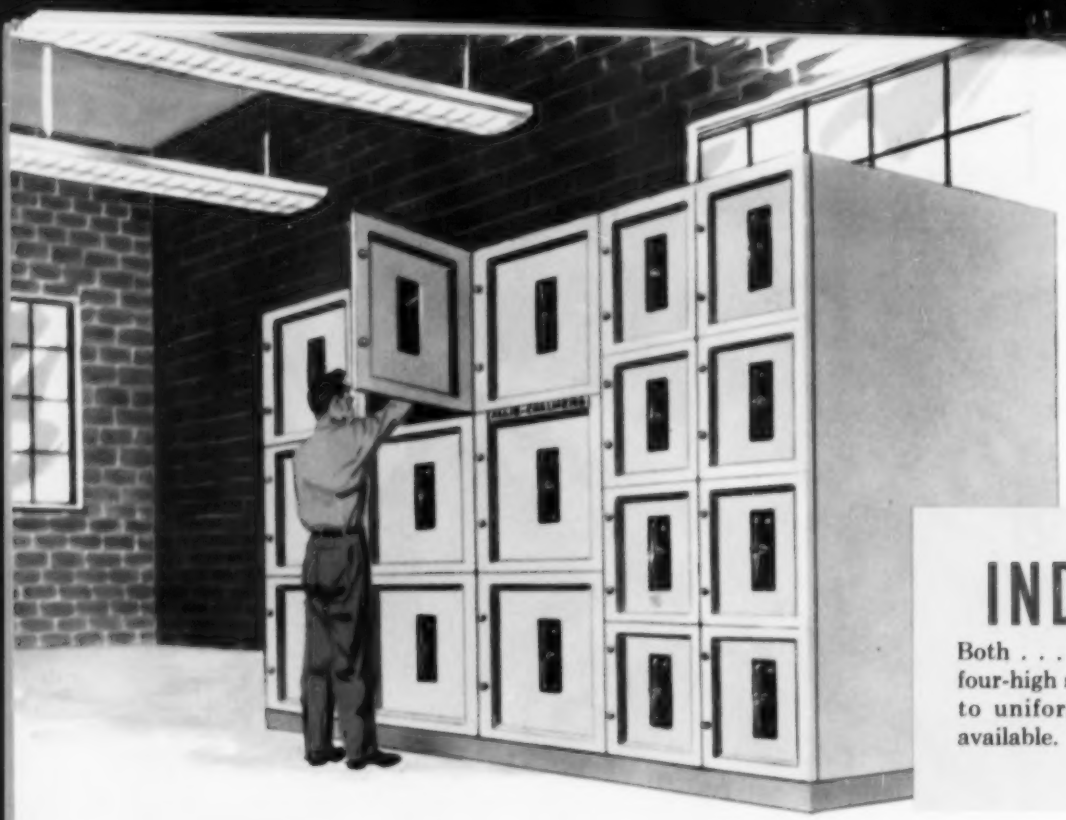
10 Position indicator
11 Stainless steel arc runners
12 Blow-on contacts
13 Primary disconnects
14 Secondary disconnects



CHALMERS

A-C ALLIS-CHALMERS



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Both . . . three-high and four-high structures, built to uniform height, are available.

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An aisle inside unit provides protection during operation, inspection and maintenance of breakers.

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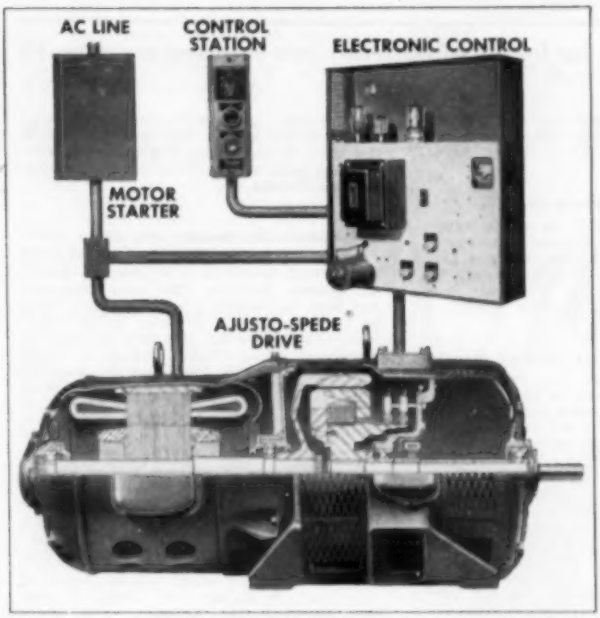

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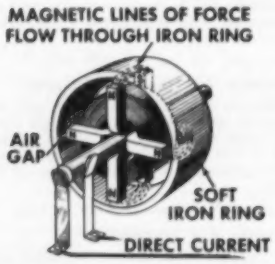
How it Works — What it Does — Why it's Better

Increased production, reduced costs, improved quality of product, and more complex processing techniques demand an ever increasing use of stepless adjustable speed drives. Dynamatic eddy-current equipment in one form or another attains these objectives.

Dynamatic Ajusto-Spede® Drives, Air and Liquid Cooled Couplings, Air and Liquid Cooled Brakes, Absorption, Motoring, and Universal Dynamometers operate on the same basic electro-magnetic principle.

A typical installation pictorially illustrates the simplicity and minimum components required to obtain controlled adjustable speed.

Basic Principles of Operation



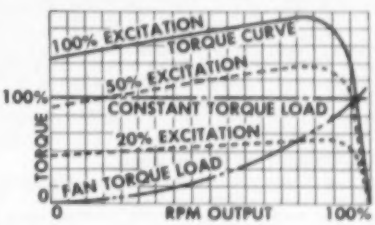
The transmitting of torque by Dynamatic eddy-current devices is based upon a simple magnetic principle easily demonstrated by the physics experiment, using a horseshoe magnet, iron filings, and a piece of cardboard. If several unmagnetized soft iron bars in the shape of a U, illustrated in the above drawing, are inserted in an insulated coil of wire, the bars will become magnets when direct current flows through the coil. Strength of the magnetic field is determined by the current flowing and the number of turns in the coil. By adding a solid ring of soft iron, encircling the poles of the electromagnets, the magnetic lines of force will flow through the ring. The basic construction of all Dynamatic eddy-current rotating equipment is then simulated.

The illustration shows magnetic lines of force with no relative rotation between the ring and magnets. When the field assembly (magnets and coil) is rotated mechanically, the iron ring separated from it by a nominal air gap remains stationary until current is applied to the coil. With the coil energized, mechanical rotation of the magnets produces movement of magnetic flux in the ring, creating eddy-currents in the ring. These induced currents develop a second magnetic field. Its strength is determined by the strength of the primary field and the relative speed difference (slip) between the two members. In the eddy-current coupling, attraction of these two fields cause the ring to follow the field magnets in rotation. When the coil current is varied, the eddy-currents will be proportionately affected, and torque produced at the output shaft will be similarly changed.

A typical eddy-current coupling torque curve with rated excitation and additional curves with reduced excitation is shown. In the same figure, a constant torque and fan torque load curve is plotted. Excess torque, which is a measure of accelerating capacity, is indicated. The Dynamatic coupling transmits this torque from a driving member, that may be either the drum ring or field magnets, to a driven member without mechanical contact.

Because of the extremely small excitation requirements, Dynamatic units lend themselves readily to electronic or magnetic amplifier control.

By taking advantage of the very high amplification factor of these controls, the largest couplings can be easily and conveniently controlled with a small adjusting potentiometer. The voltage output of a permanent magnet alternator mounted on the coupling output shaft varies directly with the shaft speed. This variable voltage signal modulates the control, automatically maintaining the selected speed of the coupling output shaft, within close limits, over a wide speed range.



Other features are easily incorporated—constant tension, controlled acceleration, threading, jogging or inching, torque limit, speed matching, and many others.

The relative simplicity, smoothness of operation, accuracy, ease of control and low maintenance of Dynamatic eddy-current equipment are factors meriting serious consideration of this type of equipment on almost all adjustable speed applications.

A free copy of the Dynamatic General Bulletin describing eddy-current equipment in more detail is available. Write for your copy.

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bulletins

. . . for listing of bulletins just received see page 16

AIR CLEANING & DUST COLLECTION

251—Using Dust Collectors

Dust collectors, including cyclone, wet or dry dynamic, and cloth screen arrestor types are the subject of a 32-page bulletin. Uses of air conditioning, ventilating, conveying, drying, and cooling units are presented. Kirk & Blum Mfg. Co.

252—Dust Collectors and Arrestors

Series of four folders describes cyclone type collector and portable, standard, and automatic bag-type dust arrestors. Also includes 32-page catalog describing exhaust fans for dust collecting and air handling. Northern Blower Co.

AIR CONDITIONING-HEATING & REFRIGERATION

254—Heat Exchanger Operation

Air-flow diagram in two-page data sheet 124 shows graphically operation of the Aero Heat Exchanger for water, oil, or compressed air cooling. How the unit saves cooling water, piping, pumping, and equipment costs is explained. Niagara Blower Co.

255—Specifying Liquid Receivers

"Liquid Receivers for Ammonia and Freon," 4-page bulletin LR-1, gives all the information necessary for specifying these units and includes elevation drawings to show typical installations. Henry Vogt Machine Co.

256—Cooling Tower is Shorter

Four-page bulletin 5.1.902 describes the LoLine, an all-new cooling tower specifically designed for air conditioning applications — with the lowest silhouette of any tower of 75 ton capacity or larger. Each component of the tower is discussed separately and a typical cross-sectional drawing shows operation. J. F. Pritchard & Co.

257—Check Your Steam Costs

"Have You Checked Your Steam Costs Lately?" This 15-page handbook is a nontechnical presentation of vital interest to everyone considering merits of replacing existing boiler equipment or purchasing new equipment. Orr & Sembower, Inc.

BOILERS & STEAM

258—Water-Tube Generator Specs

Completely packaged Water Tube Type D Superior Steam Generators in 17 sizes, with capacities from 8000 to 40,000 lb of steam per hr, are described in detail in eight-page catalog 5M-54. Superior Combustion Industries, Inc.

259—Versatility of Spreader Stokers

Spreader stokers said to be adaptable to all types and makes of modern steam boilers and generators, from 5000 to 75,000 lb per hr steam output capacity, are described in 14-page brochure 800. Various installations using Roto-Stoker Type CC stokers are shown. Detroit Stoker Co.

260—Latest in Underfeed Stokers

The latest refinements in single retort underfeed stokers are discussed in 12-page catalog SB53. Both the fluid ram and gear drive units are described in detail by means of text, elevation drawings, and cut-away views. Erie City Iron Works.

263—Modern Ways of Burning Coal

"Burning Bituminous Coal the Modern Way," contains 24 pages of case histories from industries of all sizes and types. Engineering survey results for equipment include annual fuel consumption and operating costs. Bituminous Coal Institute.

264—New Tube Cleaner

Bulletin 43 introduces a new geared tube cleaner for removing scale in heat exchanger and condenser tubes of ⅜ to 2½ in. ID. The unit is said to be particularly effective where conditions require low speed and great power. Airetool Mfg. Co.

265—Shows Products and Facilities

"Products and Facilities," 69-page general catalog G-63-A shows representative examples of products manufactured and some of the numerous facilities for producing them, together with illustrations of installations. Babcock & Wilcox Co.

266—Fintube Boilers

Fintube boilers and heat transfer products incorporating this company's 17 years of design experience in the chemical and petroleum industries are described in six-page folder 542. Brown Fintube Co.

267—Multi-Fuel Package Generator

Six-page foldout B-3100 describes in detail the Ticosteam package steam generator, a forced draft, fire tube, horizontal boiler fitted with burners of special design permitting use of any desired type of gas or fuel oil. Titusville Iron Works Co., Div. of Struthers Wells Corp.

268—Water-Tube Steam Generators

Packaged water-tube steam generators, Type MH, furnished for oil or gas firing or both, with automatic, semi-automatic, or manual combustion controls, are covered in detail in 16-page bulletin MH3-54. Union Iron Works.

271—Package Steam Generators

Seven-page bulletin AXY-1 gives full operating details and describes changes that have been made in the Amesteam generator, which is factory assembled, for 15 through 200 psi pressures. Ames Iron Works, Inc.

273—Get Free Boiler Survey

Here's how to get a boiler survey without obligation. Write for this bulletin covering the new CB self-contained boiler. Illustrations of installations, cut-away views of the boiler, and articles on how the units have proved themselves in specific applications are included. Four pages. Cleaver-Brooks Co.

274—Saves Feedwater and Btu's

Recover practically all of the heat of the blowoff water in a continuous blowoff system. Bulletin 5700 uses diagrams and text to explain how this steam may be used to heat feedwater in an open or deaerating heater and how it may be condensed in a closed heater or flash condenser to heat feedwater at a point beyond the deaerating heater. Cochrane Corp.

275—Boilers and Stokers

Over 88 years experience are embodied in the design and construction of Scotch Marine type portable boilers says 28-page catalog. Photographs and cross-sections illustrate various models ranging in capacities from 6 hp up to 25 hp. The James Leffel & Co.

277—Vertical Unit Boiler

More than 25 years of development, manufacturing, and application experience are reflected in the design of the Type VU-10 vertical-unit boiler described in 16-page bulletin VU 10-8. Advantages and design features are discussed. Combustion Engineering, Inc.

280—Prefab Oil and Gas Burners

Advantages of preassembled oil, gas, and combination oil and gas burners are listed in eight-page bulletin P-152. Units in sizes from 30 to 900 hp are listed for four common gas pressures and all grades of oil. Coen Co.

281—Better Ash Handling

Boiler plants can enjoy efficient ash handling with the use of the system described in Data Sheet Za. The system is designed to convey boiler bottom ash and fly ash in a dry state to a temporary storage silo for ultimate disposal. It employs a steam jet exhauster to produce necessary vacuum. The silo, furnished with an unloader that mixes water with the ash, is also covered. Four pages. The Allen-Sherman-Hoff Co.

BUILDING MATERIALS & MAINTENANCE

283—Efficient Floor Maintenance

"Handbook of Building Maintenance" gives valuable information on keeping your plant in efficient working order. Instant-Use concrete floor patch is described along with other materials for repairing floors. Flexrock Co.

284—Repair Leaks with Cement

Text and illustration in this 48-page handbook present repair methods for leaks in pipes, boilers, radiators, concrete, cinderblocks, and sheet and plate metal. Directory describes 12 repair cements and jobs they will do. Smooth-On Mfg. Co.

NOTE—Each bulletin item has a key number for your convenience in asking for a free, personal copy. Circle key numbers on reply card facing page 81.

COMPRESSORS & BLOWERS

288—H.D. Compressors are Dependable

Bulletin L-675-B1B describes belt-driven and direct-connected motor-driven compressors in detail. These horizontal duplex-type compressors operate at moderate speeds for heavy-duty continuous service. Exclusive Feather Valves are discussed. 36 pages. Worthington Corp.

289—Find Out Your Air Wastage

"A Better Air Power System," Folder 213A points out that power losses in compressed air lines are frequently as high as 30 to 50 percent. It describes just how to go about finding out if more air is being wasted than the repair and renovation of the distribution system would cost. Six pages. Ingersoll-Rand Co.

291—Compressors Described

Horizontal heavy duty air and gas compressors, Type T, are described in 15-page bulletin 728-8. Cross sections of crankshaft, inlet valve unloading system, compressor cylinder and valves, and the complete compressor add to the value of the booklet. Chicago Pneumatic Tool Co.

CORROSION CONTROL

292—Newest Paints Described

"Subox and Subalox Anti-Corrosive Paint — 30th Anniversary," replaces the 25th anniversary issue you have in your files. It covers these paints as previously made and includes the newer varieties. Case histories show successful use of Subox paints on various types of industrial equipment. Subox, Inc.

ELECTRICAL DISTRIBUTION

293—Facts, Figures on Air Breakers

Bulletin 5107-DR-1 contains four pages of facts, figures, features, and photographs on types KA, KB, KC, and LG Urelite air circuit breakers, and on weatherproof and dust-tight enclosures. I-T-E Circuit Breaker Co.

294—Data on Protected Transformers

"Allis-Chalmers Protected Distribution Transformers," eight-page bulletin 61B-7309B, gives operating advantages of the transformers available in rating of 3 through 100 kva, 2400 to 14,400 v, and mechanical data on five type designations. Allis-Chalmers Mfg. Co.

295—Variable Transformer Data

Types 136 and 236 Powerstat Variable Transformers — design, new ratings, and performance — are discussed in eight-page bulletin P354. The Superior Electric Co.

296—Current Limiting Fuses

Hi-Cap fuses for the protection of loads above 600 amp are described in six-page bulletin HCS. Two handy charts are included: Current Limiting Effect and Opening Time Curves. Use of these fuses in conjunction with Fusetron fuses is explained. Bussmann Manufacturing Co.

298—Latest on Dry Transformers

"Latest Developments in Dry-Type Transformers," seven-page catalog 153-A, presents the advantages of air-cooled units designed and constructed primarily for inside installations. Sorgel Electric Co.

299—Easy Power Factor Correction

Booklet 50B, 27 pages, describes the Unit-Cell Box Type Capacitors which offer easy-to-install, economical means of cor-

(more bulletins on page 76)

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Steam Generators

This famous power package is shop-assembled, shipped complete with all components installed, and occupies a minimum of space in the plant. You couldn't ask for a more efficient, dependable and simple-to-operate unit—as you'll agree when we give you the details! Let us have your requirements, without obligation.

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names make news

. . . personalities from industry & power

The Griscom-Russell Company recently elected **Graham Claytor,** one of the country's outstanding public utility executives, as one of its directors. The company was recently acquired by **General Precision Equipment Corporation.**

Resek

Harcus

Cleaver-Brooks Company reports that **J. Vern Resek,** sales manager of its Hev-E-Oil Burner Division has been appointed a member of the committee to set up standards for manufacture of oil burners in Canada.

Byron Jackson Co.'s executive vice president, **Robert Harcus,** has been appointed to the Membership Advisory Council of the Atomic Industrial Forum, it was announced recently by Admiral Earl W. Mills, UNS (Ret.), chairman of the committee.

American Chain & Cable Company, Inc. has elected **Cyrus N. Johns,** president, as its chief executive officer. Johns succeeds **Wilmot F. Wheeler. Arthur C. Laske** becomes treasurer and continues as secretary. **Wilmot F. Wheeler, Jr.** was elected a vice president. **H. L. Cummings** has been appointed general manager of the **R-P&C Valve Division.** He joined American Chain & Cable in 1938 as an industrial engineer.

General Electric Company has elected **Harold A. Olson** as a commercial vice president, and **Edmund K. Nock** has been named supervisor of land sales of its Medium Steam Turbine, Generator, and Gear Department. **Douglas A. Hopper** has been named general manager of the welding department at York, Pa. **George K. Megerian** is now manager of marketing administration and personnel development for GE's Aircraft Accessory Turbine Department at Lynn, Massachusetts. **Richard A. Schaus** has been named manager of induction and miscellaneous equipment engineering for the Industrial Heating Department.

Westinghouse Electric Corporation has elected **Chris H. Bartlett,** of the manufacturing and repair division, and **Charles C. Shutt,** of the small motor division, as vice presidents.

Alco Products, Inc. has named **Richard B. Fairman** as product manager of stationary and marine diesel engines. He will continue to be located in Schenectady. **James J. Reynolds** has been named as vice president of operations. He was formerly vice president of industrial relations.

Markson

Koger

Hagan Corporation has named **A. A. Markson** assistant vice president in charge of engineering. Markson is nationally known for his pioneer work in heat transfer through boiler tubing.

Rome Cable Corporation directors have elected **Glenn Koger** a vice president of the corporation. He will continue to act as manager of the company's Torrence, Calif. plant.

Reynolds Metals Company has appointed division staff engineer **Durwood J. Hedgecock** as chief engineer. **C. E. Coghill,** treasurer of the company was made a vice president. **John Krey,** assistant to the president, and **W. Monroe Wells,** assistant vice-president of operations, were made vice presidents.

J. F. Pritchard and Company, manufacturer of cooling towers for air conditioning and industrial applications, has appointed **Factory Sales & Engineering, Inc.,** of New Orleans as its sales representative for Southern Louisiana and Mississippi.

Allis-Chalmers Manufacturing Company re-elected **Robert S. Stevenson,** president, and other directors at its annual shareholders' meeting. **William A. Yost, Jr.** has been appointed to the newly created post of vice president for staff operations. **Dr. Henry Carroll,** nuclear physicist, has joined the company's research division. He is the inventor of a modified Atwood's machine for the measurement of gravity acceleration.

Cummins Engine Company, Inc., has promoted **E. D. Tull** to executive vice president. Newly elected vice presidents are **R. B. Stoner,** personnel and **C. R. Boll,** sales. **P. J. Every** has been named general sales manager.

Continental Foundry & Machine Company announces that James D. Baker has been appointed as director of **Copes-Vulcan Division.** Mr. Baker was formerly a field engineer for the Combustion Engineering Corporation. **The Hessler Company** has been appointed as representatives for Copes-Vulcan products out of Kansas City.

Simon

Nielsen

C & D Batteries, Inc. has elected **John F. Simon, Jr.,** plant superintendent, to the board of directors.

The Babcock & Wilcox Company has elected **M. Nielsen,** vice president, to the newly created post of executive vice president. He was also re-elected to the board.

Graver Water Conditioning Co. has announced the appointment of **J. D. Crell** as sales engineer for the New York district. They also announce the appointment of the **Allen-Shuff Corporation** as sales representatives in Eastern Arkansas, Northern Mississippi and Western Tennessee.

The Kirk & Blum Manufacturing Company recently held the annual dinner of its "25 Year Club." New members of the club, who were presented gold watches, are **B. J. Wilke** and **L. H. Stortz.**

Ajax Flexible Coupling Co. announces the election of officers. **Wayne Belden,** elected president, **Charles W. Belden** is vice president, **Harley E. Northrop** becomes treasurer, and **Robert G. Cady** is secretary.

Square D Company announces the appointment of **James F. Magin,** vice president and director, as general manager of the company's Industrial Controller Division.

Plomb Tool Company has announced the appointment of **G. E. Jones** as vice president and manager of the company's PROTO Tools Division. He succeeds **Claude Boring** who recently resigned.

Raybestos-Manhattan, Inc., Packing Division, has promoted **Bruce W. Thomas** from special representative at Manheim to eastern district manager. **John McKinlay** will replace Thomas as special representative.

Cooper-Bessemer Corporation has appointed **Dwight R. Craig** as administrative assistant—engineering department. He was formerly assistant chief research engineer with the company.

Syntron Company has named **C. W. Ramaley,** sales application engineer in selenium rectifiers for three years, as manager of the rectifier department. **James Scott** will become sales application engineer.

Chain Belt Company has appointed **George H. Woodland** to the newly created position of general sales manager, industrial divisions.

Solar Electric Corporation announces the recent appointment of **Walter J. Dremann** as president. Dremann came to Solar in 1949 as chief engineer.

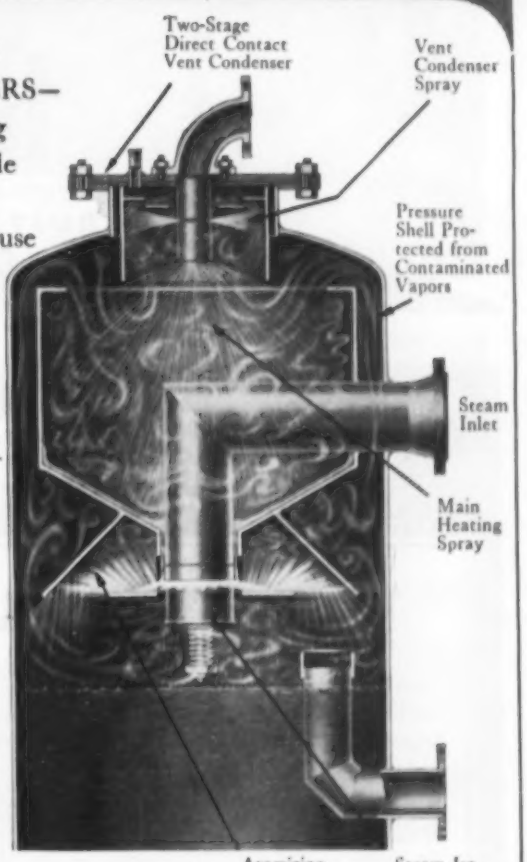
ON WATER CONDITIONING CONSULT AMERICAN ... first

advanced engineering is the important factor in

AMERICAN

water conditioning service

TO DEAERATE TURBID WATERS— or Waters Tending to Clog or Corrode Tray Deaerators —or for shipboard use the AMERICAN Atomizing SPRAY DEAERATOR is ideal



Its two-stage counterflow construction uses clean entering steam for final deaeration. It performs at low loads as well as at high. There is no slam or hammer, no counterweight. May be had with direct contact vent condenser (as shown) or with external surface vent condenser.

Write for copy of Booklet 400

SERVICE SINCE 1902 TO THE INDUSTRY

AMERICAN Water Softener COMPANY

INCORPORATED

PHILADELPHIA 33, PENNSYLVANIA

Circle 528 on reply card for more data

For Larger-Boiler Fly Ash Collection and Valuable Dust Recovery

BUELL 'SP' ELECTRIC PRECIPITATOR

BUELL MECHANICAL CYCLONE SYSTEM

Solves Big Problem for Small Boiler Operators!

Buell 'LR' Collector gets 99% of all 100-mesh and larger cinder discharge. Top efficiency for boilers from 100 to 2000 BHP.

Draft loss so low you can use 'LR' on the smallest natural draft boilers.

Get all the facts—write for 'LR' Bulletin. Buell Engineering Company, Dept. 90-F, 70 Pine Street, New York 5, New York.

buell

Engineered Efficiency in

DUST COLLECTION

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NON-FLUID OIL

TRADE MARK REGISTERED

THE PERFECT PRESSURE LUBRICANT

Common greases break down under pressure, to choke the lubricating system. NON-FLUID OIL — the Modern Lubricant that "Stays Alive" longer — will not separate, contains no residue of any kind to clog fittings, and will not allow bearings to run dry.

For longer, more efficient and economical lubrication, specify NON-FLUID OIL and be sure. NON-FLUID OIL is a must for pressure lubrication because it stands up better and cuts "down time" of valuable machinery.

Write now for free on-the-job testing sample and a useful bulletin No. 522.

NEW YORK & NEW JERSEY LUBRICANT COMPANY

292 Madison Ave., New York 17, N. Y. ● Works: Newark, N. J.

WAREHOUSES: Birmingham, Ala. ● Atlanta, Ga. ● Columbus, Ga. Charlotte, N. C. ● Greensboro, N. C. ● Greenville, S. C. ● Chicago, Ill. Springfield, Mass. ● Detroit, Mich. ● St. Louis, Mo. ● Providence, R. I. Also represented in other principal cities.

NON-FLUID OIL is not the name of a general class of lubricants, but is a specific product of our manufacture.

Circle 530 on reply card for more data

bulletins

. . . starts on page 16

recting low power factor for large or small power consumers. Sprague Electric Co.

300—Outdoor Service Equipment

Designed to make easier the selection of outdoor service equipment, 12-page bulletin 2016 combines descriptive data on all available standard equipment—service entrance, receptacle type, dual control, three-phase units. Heinemann Electric Co.

301—Improved Solid Shaft Motors

Improved types of U. S. vertical solid shaft motors, including Unimount motors in ratings from ¼ to 400 hp in grease and oil lubricated types and U.S. footless type horizontal motors for direct connection, are illustrated and described in bulletin 1868. U. S. Electrical Motors, Inc.

ELECTRIC UTILIZATION

303—How to Apply Electric Heating

Industrial electric heating applications and methods are described in 32-page booklet, "101 Ways to Apply Electric Heat." Illustrated case histories show experience-tested ways to apply metal-sheathed Chromalox electric heating units in industrial jobs. Edwin L. Wiegand Co.

304—Surface Heating

"Handy Selector Guide for Surface Heating," four-page folder GEA-6146, shows which type of heater to use for specific jobs, how to determine heater rating, how to calculate heat-up time, and how to select thermostats. General Electric Co.

HEAT EXCHANGERS & WATER HEATERS

305—Heat Exchange Equipment Specs

This 16-page bulletin gives all pertinent specification data for hot water storage heaters, instantaneous and converter heat exchangers, instantaneous and converter water heaters, and fuel oil heaters. Patterson-Kelley Co., Inc.

INSTRUMENTS & CONTROLS

306—Automation Dictionary

This "Automation Dictionary" covers some 87 words and phrases in the expanding vocabulary of automation. These are not standard engineering definitions but new engineering terms defined for the average engineer. Minneapolis-Honeywell Regulator Co., Industrial Div.

308—Control Valve Reference Book

Three basic types of single seated diaphragm control valves are discussed in 15-page bulletin 5304. Cut-away views and charts with complete specification data make this a good reference book. Leslie Co.

309—Control Those Temperatures

Temperature control by means of temperature regulators that combine both a pressure and thermal element is discussed in four-page folder 1008. Spence Engineering Co., Inc.

310—Liquid Level Equipment Specs

Liquid level gages, water columns and

allied equipment for industrial, chemical, and power plant service are covered in bulletin 11-1-51. Specification and application data are included. Ernst Water Column & Gage Co.

311—Combustion Controls

A factual and photographic roundup of how this company's Automatic Combustion Control systems are being used with various types of gas-fired boilers is presented in 14-page bulletin MSA-116. This booklet gives basic information about the right kind of combustion control practices for gas-fired generators. Hagan Corp.

312—New Combustion Sampling

The full story of a newly developed sampling system for continuous trouble-free sampling and oxygen measurement of combustion processes is told in bulletin 703. The equipment described is designed for steam generating plants, rotary kilns and driers, open hearth furnaces, and tanks. Arnold O. Beckman Co., Inc.

316—Measure Feedwater Gas

Described in four-page folder 148BP is an analyzer for measuring dissolved oxygen and hydrogen in feedwater. Advantages, ranges and accuracy are discussed. Cambridge Instrument Co., Inc.

317—Fully Automatic Controls

Specifications for the fully automatic, all electric metering type packaged controls for shop assembled boilers are given in four-page bulletin 54-1088-239. Schematic drawing shows a typical packaged control system. The Hays Corp.

318—Screw-on Sight Flow Indicators

Sight flow indicators that can be easily and inexpensively installed in any pipe line from ⅛ to 2 in. NPT are shown in Catalog Sheet 253. Two pages. Jerguson Gage & Valve Co.

LUBRICATION

319—Diesel Lubrication Revised

Written for everyone interested in the lubrication of diesels, "Lubrication of Diesel Engines," has been revised as technical bulletin B-1, 48-pages. It discusses diesel principles and design, types of engines in use, operating cycles, accessories and choice of lubricants. Sun Oil Co.

320—Stop Oil Contamination

Eight-page bulletin F-132 describes in detail construction and operation of hydraulic systems with special emphasis on contamination of hydraulic fluids from various causes, and demonstrates the correct filtration system. The Hilliard Corp.

321—The Story of Bearing Lubrication

"Industrial Bearing Lubrication" is a reprint from the magazine **Lubrication**, October, 1954, issue. The article covers bearing design, surface, overhaul, and aspects of lubrication. The Texas Co.

322—Proper Motor Lubrication

"Lubrication of Electric Motors: Ball and Roller Bearing Type," four-page bulletin 504, fully describes proper methods for lubricating and cleaning ball and roller bearings on electric motors. New York & New Jersey Lubricant Co.

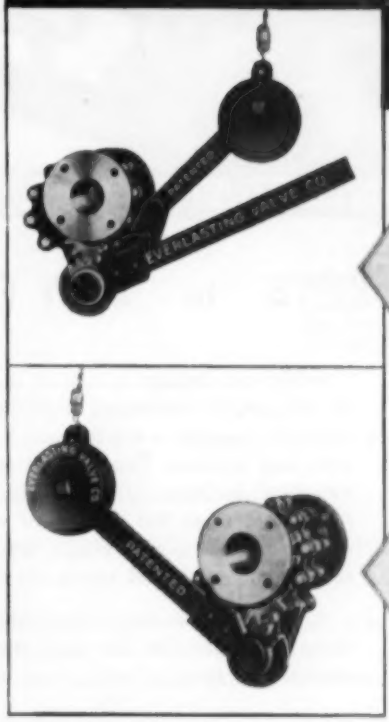
MATERIALS HANDLING & STORAGE

323—Story of Tile Storage Bins

"Vitrified Glazed Tile Industrial Storage

(more bulletins on page 83)

For Everlasting Protection in Emergencies



OPENING TYPE
to divert water to sprinkler deluge or water curtain systems, or to divert inflammable liquids to a point of safety.

Write for Bulletin E52C

CLOSING TYPE
to shut off the flow of inflammable liquids or to concentrate water or steam in fire mains.

Both types can be controlled thermostatically, electrically, or manually from any or many locations. Their design assures positive, dependable protection because they do not wedge and consequently cannot stick.

EVERLASTING Valves

EVERLASTING VALVE CO.
41 FISK STREET, JERSEY CITY 5, N. J.

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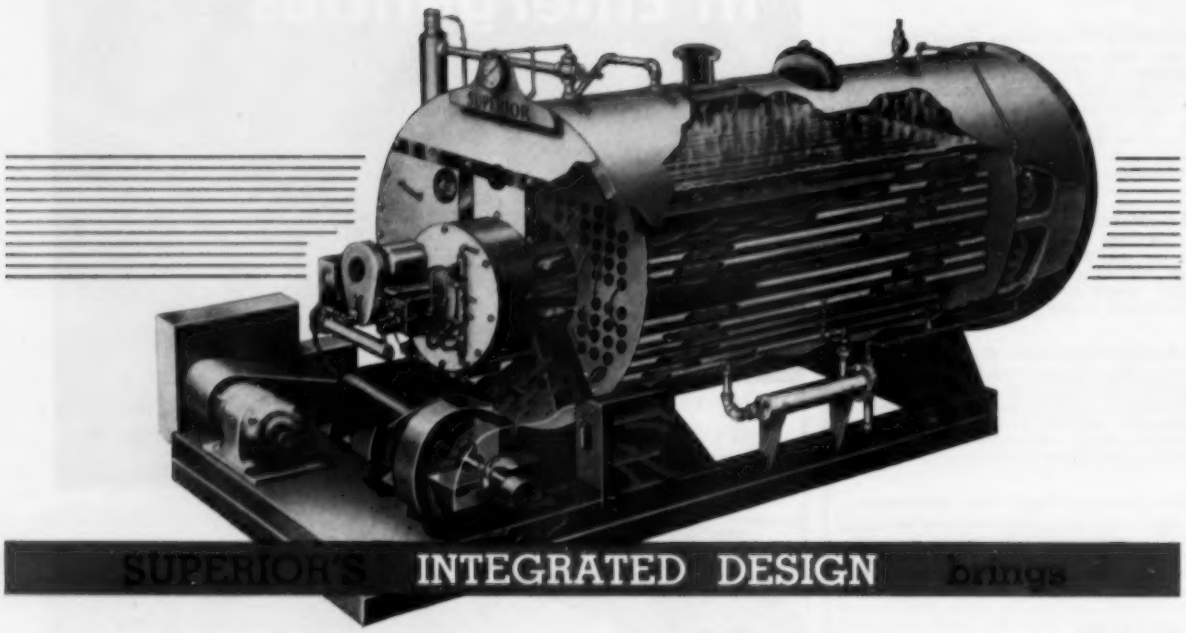
MAXIMUM { HEAT TRANSFER / STEAM RELEASE / LIFE



SUPERIOR'S INTEGRATED DESIGN brings

the THREE KEYS to LOW COST STEAM

Superior Steam Generators burn oil or gas or both; are available in 18 sizes from 20 to 600 b.h.p. and pressures to 250 p.s.i. or for hot water. Write today for complete details in Catalog 702.

Integrated design is one of the most important advantages of completely packaged Superior Steam Generators. Components of these units are designed and built to operate efficiently with one another. This careful sizing and matching of burner capacity, heating surface, steam space and evaporating surface, eliminates the danger of waste due to excessive stack temperatures, or wet steam which results from surging and foaming in restricted space on the water side.

Bigger, heavier, more thoroughly engineered Superior Steam Generators provide the most steam per dollar over a longer serviceable life.

for performance you can **BANK** *on*

SUPERIOR COMBUSTION INDUSTRIES INC.
TIMES TOWER, TIMES SQUARE, NEW YORK 36, N.Y.

SUPERIOR STEAM GENERATORS

Circle 532 on reply card for more data

REPLY CARDS *are to be used to request more information on advertised products, new equipment, or bulletins for your data file listed in this issue.*

ADVERTISED PRODUCTS from Readers' Guide listings on page 81

NEW EQUIPMENT and new developments start on page 10

DATA FILE BULLETINS and catalogs start on page 16

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key numbers and your requests will be given prompt attention.

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ADVERTISED PRODUCTS

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NEW EQUIPMENT

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readers' guide

. . . industry & power's advertised products

The table below lists, according to product groupings, all equipment advertised in this issue. To request more data, circle key numbers on reply card, facing page 81.

Key No.	Advertiser	Product	Page No.
AIR FILTERS AND DUST COLLECTORS			
529	Buell Engineering Co.	Dust Collectors	76
BOILERS AND BOILER ACCESSORIES			
519	Bituminous Coal Institute	Coals	29
553	Chesapeake and Ohio Railway	Coals	97
522	Detroit Stoker Co.	Stokers	33
502	Enos Coal Mining Co.	Coal handling equipment	6
550	General Coal Co.	Coals	94
504	Jerguson Gage and Valve Co.	Liquid level gages	8
538	Liquidometer Corp.	Tank gages	86
511	National Airoil Burner Co.	Oil burners	18
510	Petro	Oil burners	17
532	Superior Combustion Industries	Steam generators	78
527	Titusville Iron Works, Div. of Struthers Wells Corp.	Steam generators	73
540	Union Iron Works	Package boilers	87
514	Henry Vogt Machine Co.	Steam generators	22
BUILDING MATERIALS AND MAINTENANCE			
534	Electro Hercules Steel Co., The	Aluminum paint	83
552	Flexrock Co.	Concrete floor patch	96
508	Kalamazoo Tank and Silo Co.	Storage silos	14
520	Smooth-On Mfg. Co.	Iron cement	30
COMMUNICATIONS			
500	Automatic Electric Sales Corp.		2
ELECTRICAL EQUIPMENT			
525	Allis-Chalmers Mfg. Co.		67 to 70
549	Heinemann Electric Co.	Circuit breakers	93
503	I-T-E Circuit Breaker Co., Switchgear Div.		7
517	Sorgel Electric Co.	Transformers	27
535	Sprague Electric Co.	Capacitators	84
ENGINES AND TURBINES			
545	Burgess-Manning Co.	Snubbers	91
513	Coppus Engineering Corp.	Ventilator	21
FILTERS, STRAINERS AND PURIFIERS			
551	Ronningen Mfg. Co.	Filters	96
HEATING, AIR CONDITIONING AND REFRIGERATION			
521	Johnson Service Co.	Temperature controls	31
INSTRUMENTS AND CONTROLS			
534	Electric Auto-Lite Co., The	Recorders	83
542	Ernst Water Column & Gage Co.	Sight flow indicators	88
538	Liquidometer Corp.	Liquid level gages	86
LUBRICANTS AND LUBRICATION EQUIPMENT			
530	New York & New Jersey Lubricant Co.	Non-fluid oil	76
MECHANICAL POWER TRANSMISSION			
526	Eaton Mfg. Co. Dynamatic Div.	Eddy-current equipment	71
501	Raybestos-Manhattan, Inc., Manhattan Rubber Div.	V-belts	3
548	Standard Pressed Steel Co. Hallowell Power Transmission Div.	Steel collars	92
PIPE, TUBING & HOSE			
544	Dart Union Co.	Unions	90
PUMPS AND COMPRESSORS			
524	American Marsh Pumps, Inc.	High pressure pumps	66
539	Aurora Pump Div. New York Air Brake Co.	Pumps	86
554	Byron Jackson Co.	Mechanical seal	98
505	DeLaval Steam Turbine Co.	Rotary pump	9
516	Worthington Corp. Vertical Turbine Div.	Fire pumps	25
REFRACTORIES AND INSULATION			
507	Universal Atlas Cement Co., Lumnite Div.	Refractory Concrete	13
STEAM SPECIALTIES			
523	Yarnall-Waring Co.	Impulse steam traps	34
TOOLS			
518	Wilson, Thomas C.	Tube cleaning equipment	28
VALVES AND REGULATORS			
537	Chapman Valve Mfg. Co., The	Check valves	85
515	Darling Valve & Mfg. Co.	Pumcups	23
531	Everlasting Valve Co.	Valves	77
547	Powers Regulator Co.	Temperature regulators	92
541	Republic Mfg. Co.	Gage protectors	88
WATER TREATMENT AND WASTE DISPOSAL			
528	American Water Softener Co.	Spray deaerators	75
506	W. H. & L. D. Betz	Water conditioning service	11
509	Dearborn Chemical Co.	Corrosion inhibiting compound	15
512	Elgin Softener Corp.	Water softener	19
546	Hungerford & Terry, Inc.	Water treatment plant	91
543	Infilco, Inc.	Water and waste treatment	89
536	L. A. Water Softener Co.	Stainless Steel Deaerator	84

spot news

. . . . about industry & power

• Finder's List of Key Engineers

Engineers Joint Council is assembling the engineering portion of a National Register of Scientific and Technical Personnel. The Register is being compiled in cooperation with the National Science Foundation. Congress has directed the Foundation to establish a list that would aid in locating key engineers in time of national emergency.

Some 8,000 of an expected 20,000 leaders in all branches of engineering have already been listed. Through these leaders, the government will be able to immediately contact those experts in particular fields needed in an emergency.

• That Urge to Merge

The rash of mergers continues. National Radiator Company, Johnstown, Pa. and United States Radiator Corporation, Detroit, have formed the National-U.S. Radiator Corporation. As a result of the merger, the new firm will market a comprehensive line of heating equipment including cast iron heating products, steel boilers, packaged steam generators sold under the name "Cyclotherm," and related items . . . Worthington Corporation announces that its Wellsville Works and its Steam Turbine Sales Division are being merged. The combined unit will be known as the Steam Turbine division . . .

Twin Coach Company will purchase all of the outstanding stock of Davey Compressor Company. Davey is one of the country's leading manufacturers of portable and industrial air compressors. Twin Coach is known as a producer of motor coaches but has diversified greatly into such fields as gasoline, propane, and diesel engines, . . . Kelite Products, Inc. has integrated several of its component corporations to efficiently handle the rapidly expanding volume of business resulting from the current high level of economic activity . . . Panellit, Inc. has acquired Jordan Electronic Manufacturing Company. Panellit makes modern automatic control and information systems.

• Expansion Programs Expand

Allis-Chalmers is launching a multi-million dollar transformer and circuit breaker manufacturing expansion program at its Terre Haute, Indiana and Gadsden, Alabama plants. The new facilities are expected to be in operation in 18 months . . . DeLaval Steam Turbine Company is starting a long-range expansion program. Land has been purchased for future construction of new buildings in Trenton and Houston. Specific building plans are already underway near Chicago and San Francisco. This announcement was made on the company's 54th anniversary . . .

Lukens Steel is speeding plans for business diversification and new product development. Of particular interest initially are plastics, contractors' equipment, highway supplies, pleasure boats, and the increasingly popular do-it-yourself field. The idea is to consider market requirements that would guide in the development—through Lukens' steelmaking, processing, and fabricating facilities—of end products to supplement its basic product line . . . U. S. Electrical Motors is about to begin the largest plant expansion in the history of its Atlantic plant. Plans call for erection of 63,000 square feet of additional manufacturing space. The original plant, built in 1940, was expected to be adequate for at least 20 years.

• Products Merge, Too

Fiberglas industrial insulations made by the Owens-Corning Fiberglas Corporation will also be produced for the Armstrong Cork Company, which will market them under the trade name "Armaglas." Armstrong expects to take advantage of the unusual properties of Fiberglas industrial insulations and thus serve its customers more effectively. Owens-Corning expects to make its materials more readily available to an increasing number of users . . .

Alco Products, Inc., (formerly American Locomotive Company) has acquired the Carter Craft fin tube process—a revolutionary new method of heliarc welding longitudinal fins to tubes for use in heat exchangers. Alco is also starting a new line of fin tube heat exchangers for the petroleum, chemical, petrochemical, and power industries that employ the advance-design tubes.

• Probe Pollution Problems

Formation of a national air pollution abatement committee made up of state and federal officials plus industry representatives has been proposed by William C. Foster, president, Manufacturing Chemists' Association. Foster pointed out that industry spends in excess of $100 million annually on pollution abatement, and that 68 bills are under consideration in 12 state legislatures dealing in one way or another with air pollution abatement. There are 20 federal bills in some state of consideration. Foster suggests that the committee might serve in an advisory capacity to the President. Though he recognizes that air pollution is local in nature, he feels that it is sufficiently widespread to require "national consideration." . . .

Speedier progress in the control of pollution from industrial sources was predicted by W. W. Jennings, chairman of the Ohio River Valley Water Sanitation Commission. He stated "Adoption of (an) industrial-waste control policy by Illinois, Indiana, Kentucky, New York, Ohio, Pennsylvania, and West Virginia, represents one of the most complex and satisfying accomplishments of our interstate agency. Having achieved unanimity of approach we are in a position now to expedite industrial waste control in the same orderly and effective fashion that municipal sewage treatment requirements were established by the commission on the Ohio River."

(more spot news on page 84)

bulletins

. . . starts on page 16

Bins," four-page bulletin 1153-B, tells you how this type of bin can keep materials clean, dry, and ready for use. Drawings show how the tiles are constructed and the simplicity of erecting silos made of these tiles. Kalamazoo Tank and Silo Co.

324—Concrete Stave Storage Bins

If you specify vertical storage construction for handling flowable bulk materials, this ten-page foldout will help you visualize how this company's Super-Concrete Stave Storage Bins might meet your requirements. The Neff & Fry Co.

325—How Idlers Are Used

Four-page bulletin LD-103 shows how the Limberoller flexible belt conveyor idler is being used in industry for above or below ground belt conveyors handling various types of materials. Dimensions and specifications are listed. Joy Mfg. Co.

326—Belt Conveyor Design Data

Engineering data required to design a belt conveyor for any application are presented in 86-page catalog 852. The booklet, published to serve as a handbook on conveyor design, states that many problems can be answered by using a standardized unit. The Jeffrey Mfg. Co.

327—Steel Shelving Featured

Photographs, cartoons, and text are used to point out the features of the new Halloweil Adjustable Steel Shelving in four-page folder 2057. The open and closed type, the ledge type, and various combinations of swinging and sliding doors are featured. Standard Pressed Steel Co.

PIPING, VALVES, & SPECIALTIES

328—Pressure Valves For All Ranges

Catalog 10 describes List 960 and 990 valves. The 960 is for a pressure range of 200 lb at 100 F to 380 lb at 1000 F. The 990 is for higher pressures. Chapman Valve Manufacturing Co.

329—Valve Selection Data

Valve users can easily obtain data on valves for a wide variety of applications by using the simplified cross index in 27-page catalog 105. The most widely used cast and forged steel Edward globe and angle stop, non-return, check, gate, hydraulic, relief, mudline, flow-off, instrument valves, and strainers are included. Edward Valves, Inc.

Torque Wrenches In Wide Range

Both inch-pound and foot-pound torquers are described in this complete 68-page catalog. Types included are for a wide range of drive sizes with plain or ratchet head. **Please send requests directly to Proto Tool Co., Dept. IP, 22762 Santa Fe Ave., Los Angeles 54, Calif., with 10c.**

330—Avoid Clogging Steam Equipment

You can prevent rust, scale, and dirt from clogging steam equipment with use of Yarway fine-screen strainers, according to six-page bulletin S-204. Tables give prices, rates, dimensions, and woven screen data. Yarnall-Waring Co.

331—Why Not a Solenoid Valve?

If you use direct operated solenoid

(more bulletins on page 90)

Solve your HOT SURFACE COATING and MAINTENANCE PROBLEMS!

Electro WHITE HEAT withstands 1600°F!

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Newly designed, Model "1000" Auto-Lite Recorder gives permanent proof of temperature behavior. • 6" clear reading chart; various standard ranges from minus 40°F. to plus 550°F. • 3 standard types; choice of 24-hr. or 7-day cycle. • Electric or mechanical chart drive. • With capillary tubing for remote reading. Priced from $49.50.

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For this 15 hp motor, power losses are corrected where it does the most good—*at the source.* A 4 kvar Sprague Power Factor Correction Capacitor across the terminals reduced reactive circuit current flow through transformers and wiring to a bare minimum . . . slashed power bills noticeably.

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ALL STAINLESS INTERNALS

eliminates corrosion of vital parts . . . specially designed to keep undeaerated water from contact with tank.

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completely self-adjusting at all loads without springs or mechanical gadgets . . . no clogging or sticking . . . no maintenance problems.

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spot news

. . . Starts on Page 82

• New Members for EJC

Engineers Joint Council has elected the American Society of Refrigerating Engineers as a constituent body. The American Institute of Industrial Engineers has been elected an associate of EJC, the first organization to become affiliated in such a category. EJC now has nine constituent societies with a total membership of more than 196,000.

• Industry Must Disperse

Lieutenant General Leslie R. Groves, who supervised development of the first atomic bomb, told the ASME that dispersal of industry and population centers is a necessary first step for defense against atomic attack. He said "One of the important things we can do is to disperse our industry and our centers of population so that there will be no key point of vulnerability . . . If we take these problems in time—looking at the situation calmly, and without panic; realistically, and without fear—we can establish a defense that will be invulnerable to decisive attack, and the power of reprisal that will make the attack virtually suicide for the aggressor."

• New Engineers A-breeding

The second industrial revolution through which we are passing right now, is already creating a new race of young plant engineers and executives—men who have the on-the-spot know how to keep today's and tomorrow's intricate complex of production machinery going. So thinks Scotney C. George, steam and maintenance engineer, Flintkote Company, Los Angeles. He said, "The young executive rising in today's industrial world must absolutely keep abreast with the myriad of new maintenance engineering concepts and products."

Speaking in relation to the forthcoming Western Plant Maintenance and Engineering Show (July 12 to 14, Los Angeles), George continued, "Recently the chief production engineer of a multi-plant raw materials manufacturing firm made the prediction that within five years nearly every large plant in the country will have an extensive maintenance engineering training program and that maintenance engineering—the ability to keep automatic production going—will be the key skill required from young engineers and executives . . . The young plant executive faces a rapidly changing industrial picture in which maintenance engineering is moving toward a front position."

• Build New Plants

C & D Batteries will begin making industrial storage batteries in its new Attica, Indiana plant this month. A skeleton crew will be brought to Attica, and the firm will employ as many local people as possible . . . Peerless Electric has just broken ground for a $350,000 plant to house its fan and blower division. The new building is part of a half-million dollar expansion program. Con-

CHAPMAN'S
CHECK VALVE

Stays Open Without Flutter, Closes Fast Without Slamming

Chapman's Tilting Disc check valve keeps maintenance costs down in the entire piping system. There's no flutter or vibration in the open position: the lightweight, airfoil-designed disc is held firmly against its stops by the fluid flow.

When flow starts to reverse, the uniquely designed disc swings quickly to the closed position, cushioned by fluid pressures, and then drops to a tight seal against the seat, without sliding or scraping. Closure is fast, tight . . . and *quiet*. Slamming is *eliminated*, in all but unusual piping arrangements.

Freedom from vibration and slamming, low wear and low head loss keep maintenance costs down, give years of more efficient service. For every check valve service, specify Chapman's Tilting Disc. Available in steel or iron, with suitable trim to meet service conditions. Full engineering data are in Catalog 30. Write for it today.

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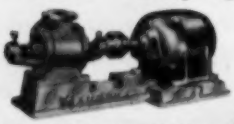
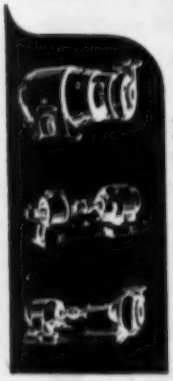
Capacities to 150 G.P.M.



Heads to 500 Ft.



APCO Two-Stage Turbine Type Pump for High Pressure Service

Apco—the pump with but one moving part, the impeller — is famous for long-lived, efficient performance on small capacity, high head duties. Available in Single Stage, Two Stage and 4-Stage Tandem for high pressures — and Water Jacketed for high temperature and highly volatile liquids.

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THE NEW YORK AIR BRAKE COMPANY

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struction will be completed by September 1. Operations are scheduled to begin December 1 . . . Insul-Mastic Corporation is transferring its home office from Pittsburgh to Summit, Illinois, a Chicago suburb.

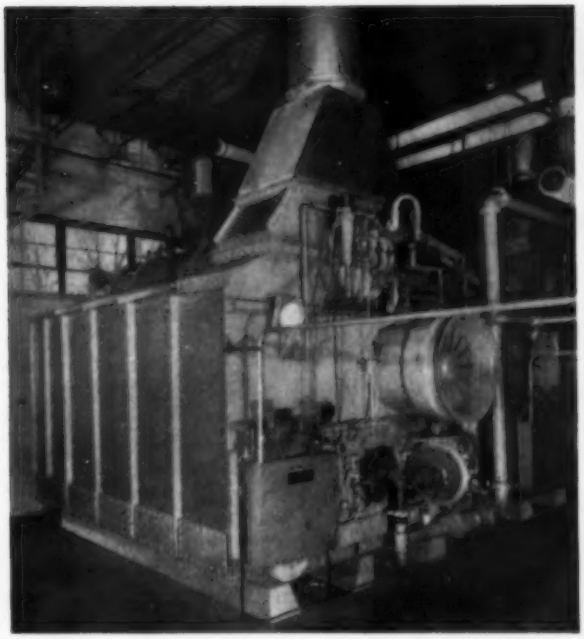
• Engineers Challenged

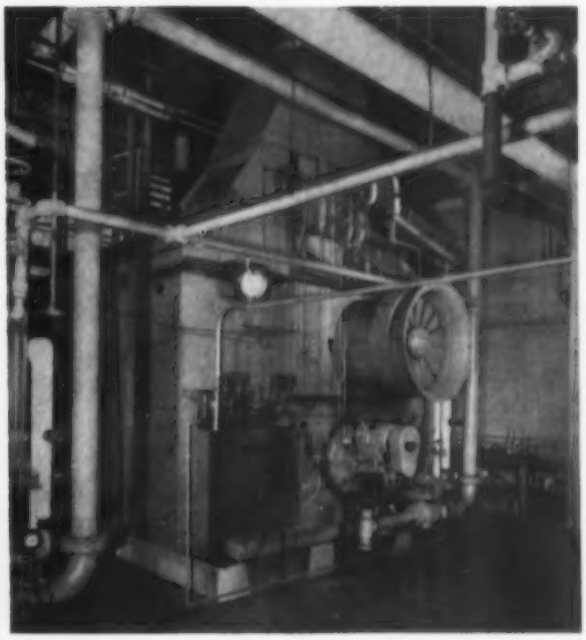
Assistant Secretary of Defense for applications engineering Frank D. Newbury says flatly that the United States does not have the technical manpower to keep prepared for "both the old and new kinds of war." He told ASME, "that if we ever lose the armament race to the USSR, it will be because the USSR has of necessity practiced a policy of selection of its objectives and concentration of its resources, concentration on heavy industry as against consumer goods, and concentration on a relatively few sizes and types of weapons and equipment in its military." . . . Another voice stated that the Soviet Union has increased its industrial output more than eight-fold between 1928 and 1953, and has doubled industrial man-hour productivity since 1928. The volume of Soviet manufacturing and mining in 1954 however, was only about 35 percent of that of the United States. The speaker is a Russian-born expert—Demitri Shimkin, social science analyst, U. S. Department of Commerce . . .

In Chicago, Dr. John T. Rettaliata, president of Illinois Institute of Technology, said that science and engineering face new challenges during 1955 which must be met to maintain American technological superiority. Recognition of future demands upon the engineering profession has resulted in national attention being given to evaluation of the engineering curriculum. Engineering educators, he continued, believe more effort should be devoted to the sciences and humanities, with less emphasis on application. He further stated "For many years, the bachelor's degree has been the accepted badge of admission to the engineering profession. But in a world of increasingly complex technology, where new developments are occurring at an expanded rate, it is becoming more difficult at the undergraduate level to prepare a student adequately." . . .

• Another Challenge

The early education of engineers came under the fire of Morris D. Hooven, 1955 presidential nominee of the AIEE. He said, "Suppose we look at a child, a bright child and a reliable child, one who has within him the possibility to become a member of the engineering profession. We are not at this moment in history doing too well with this youngster. There have been odd deviations from the three R's which have been introduced into our educational system which seem at least to have had the result of making less people desirous of serving our technology than previously . . . Many engineering colleges report that they must give a year of additional work in order to bring a possible engineering freshman up to high school graduate level in science and mathematics." . . . The United States needs more professional engineers in all levels of government and more reliance on engineering judgment in public affairs. So thinks Col. Willard F. Rockwell, chairman of the board of Rockwell Manufacturing Company. "Every time I have been called to testify before Congressional committees," he said, "I have been surprised to find how seldom our Congressmen call on the engineering profession for testimony when the solution of a question under investigation requires expert engineering advice."





Union packaged boiler twins perform two key jobs for modern mid-west feed plant

Job Report (UIW)—Side by side in the Springfield, Missouri plant of Consolidated Products Company, two Union Type "MH" Packaged Steam Generators play a dual role in the manufacture of livestock and poultry feeds. They produce steam for processing milk by-products and for building heat.

Reported to "have proven very satisfactory and dependable sources of steam" by Consolidated, these packaged units were completely shop-assembled by Union Iron Works in Erie, Pa. before shipment to their midwest job site. Each of the pair has a steam capacity of 22,500 lbs. per hour and is equipped for burning heavy oil or gas.

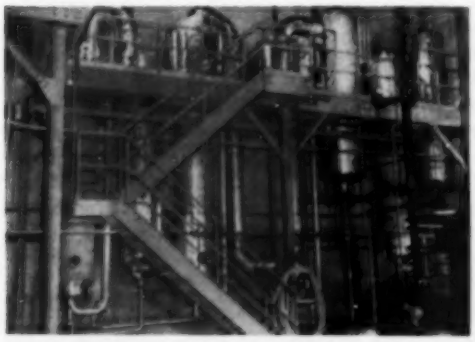
Stressing the selection of MH Steam Generators "on the basis of good design," Consolidated Products Co. adds, "Union Iron Works had previously given us excellent service on several coal-fired, water tube boilers."

From Oregon to Alabama, Union Type MH Steam Generators have been installed in breweries, chemical processing plants, pulp and paper mills, refineries, schools and institutions, to name but a few.

Patterned after larger but similar field erected Type H Boilers, originated by Union over 16 years ago, shop-assembled MH Units can be equipped to handle multitudes of needs formerly requiring costly field erection and special engineering. Superheaters can be installed to meet total temperature requirements, while both air heaters and economizers are readily supplied when needed.

Standard units are designed in 13 sizes from 10,000 to 40,000 lbs. of steam per hour at 250 psi, with higher pressures available for special applications.

The complete story on Union Type MH Steam Generators, including cut-away illustrations, tube layouts and dimension tables, can be obtained promptly by requesting Bulletin MH-353 from Union Iron Works, Erie, Pa.



VACUUM CONDENSING EQUIPMENT inside Springfield plant utilizes steam produced by MH Units to process milk by-products.

SPRINGFIELD BLENDING PLANT — One of 38 plants operated by Consolidated Products Co. to produce livestock and poultry feed.

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PROTECT your expensive gages from damage with Republic Gage Protectors and Pressure Snubbers.

Fluid hammer, chattering check valves, and severe pressure fluctuations can cause extreme shock, and damage gages. Pressure Snubbers absorb shock and permanently protect gages against damage from wild fluctuations, without affecting accuracy.

Adjustable Gage Protector (illustrated) automatically cuts out gage when system pressure rises above gage range, and reopens when pressure drops. Working pressures to 10,000 psi.

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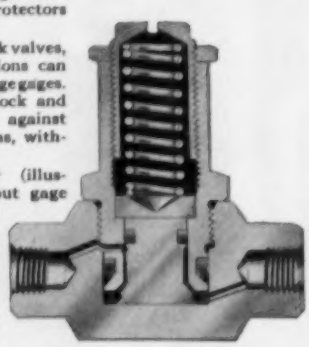

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For insertion into pipe

FOR EVERY APPLICATION

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FIG. 29 Cylinder with Impeller

FIG. 17-28 Cylinder

FIG. 215 Flanged

FIG. E-57 Double Window

FIG. 212 Visibility Welding Neck or Screw

FIG. E-811 Flapper

FIG. E-1810 Rotating Wheel Type

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Steel Structures Painting Manual, Volume Two, edited by Joseph Bigos, director of research, Steel Structures Painting Council; 292 pages; $6.00.

This is the second of two volumes that comprise a comprehensive set of recommendations for the painting of steel structures and surfaces located in a wide variety of environments. Volume One was primarily concerned with good painting practices for specific structures — such as vessels, underground structures, and chemical plants.

Volume Two is chiefly concerned with specification systems that permit ordering a painting job by reference to a number in much the same manner as steel itself is specified by a particular number. These specification systems include surface preparation, pre-treatment, application techniques, and paint compounds.

Of particular interest is the specific attention given to maintenance painting. The book is so very well organized that no one should have any trouble finding fully correlated, comprehensive information to cover all aspects of a given situation.

Perhaps the best to be said about these volumes is that they take the paint-bucket brigade out of the slap-dash realm it has traditionally occupied, and put industrial painting into a well organized comprehensive domain which commands as much engineering respect as do the more formally organized realms of industry's power services.

Heating, Ventilating, Air Conditioning Guide, 1955, Volume 33; American Society of Heating and Air-Conditioning Engineers; 1680 pages plus psychrometric chart; $12.00.

This is the latest revision of a book that has already come to enjoy wide acceptance. Most noteworthy about the 33rd edition is the up-to-the-minute character of the new material introduced. High-temperature water systems are discussed for the first time. District heating, design of gravity systems, corrosion, and scale prevention are among other topics that have come in for extensive re-writing for this edition.

Of particular interest to engineers responsible for industry's power services are improvements in chapters on air contaminants, heat transmission coefficients of building materials, steel boiler rating tables, piping and fittings, industrial insulation, district heating, motors and motor controls, industrial exhaust systems, and water-formed deposits.

The Technical Data Section now comprises 1160 pages, exceeding the previous edition by 32 pages. The Catalog Data Section has been enlarged to include information on products of 328 well known manufacturers. The entire volume is well indexed

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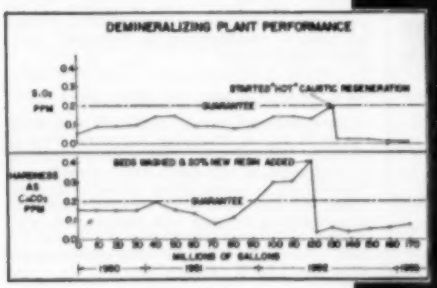
"CATEXER" "ANEXER" Demineralization Plant performance charts at Waukegan Station.



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When you specify an INFILCO Demineralization Plant, you can rely on its performance because it is designed by a firm with the widest range of engineering know-how in the water and waste treatment field. For more information see your Consulting Engineer or write.

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bulletins

. . . starts on page 16

valves for automatic or remote flow control of liquids and steam up to 400 F, or of high viscosity liquids you will want to read 11-page bulletin V-2. Normally closed, normally open, explosion-proof normally closed, and three way valves are shown. The Johnson Corp.

332—Steam Jacketed Valves

"Viscous Materials," four-page folder E-200, will be of special interest to engineers of plants in which viscous materials are handled. Illustrations of steam-jacketed valves include a large cross section and an exploded view. Everlasting Valve Co.

333—Advantages of Steel Unions

Advantages of a patented, inexpensive steel union of new design, with one inserted bronze seat and polygonal pipe ends, made of rugged pipe coupling stock, are pointed out in bulletin P-100. Dart Union Co.

334—Steam Traps and Specialties

Catalog 68G, 31 pages, describes and illustrates steam traps, strainers, regulating and reducing valves, separators, and vacuum and lifting traps. Strong, Carlisle & Hammond Company.

335—Snubbers Reduce Noise

Explosion resistant snubbers, known as the BEC, BES, and BEO lines, for commercial, standard, and optimum silencing respectively, are described in eight-page bulletin 252. Each type is shown in an elevation drawing accompanied by photos of typical installations in industry. Burgess-Manning Co.

337—Data on Pipe Fabrication

Specifications for all sizes of pipe from ⅛ to 24 in. in diameter are presented in 16-page catalog 575C. Tables give data and descriptions of standard, extra strong, and double extra heavy pipe, spiralweld pipe, large OD pipe, line pipe, electric-weld tubing, welding fittings and flanges, oil well casing, and water well casing. Facilities for fabricating pipe for structural uses also are discussed. L. B. Foster Co.

339—Selecting Ball Float Traps

Ball float traps for draining water from air, gas, or steam lines or for draining light liquids from gas under pressure are described in eight-page bulletin 289. An orifice capacity chart and tables of maximum operating pressures help in selection. Armstrong Machine Works.

341—Valve and Regulator Data

Specifications and operational data for steam, gas, air, oil, and water regulating equipment are presented in 60-page catalog 54. Illustrations and descriptions are included for pressure, temperature, and combination regulators, diaphragm, float, motor, solenoid, pop, and relief valves. O. C. Keckley Co.

342—Pneumatic Relays and Pilot Valves

Two-page leaflet 350 describes pneumatic relays and pilot valves, pressure-electric switches, and electric pneumatic valves. Included are gradual direct acting relays, gradual reverse acting relays, and gradual retarded, advanced, and minimum pressure relays. The Powers Regulator Co.

(more bulletins on page 92)

so that there should be no problem in locating specific information among its many pages.

Interior Electric Wiring — Industrial, by Kennard C. Graham; American Technical Society; 324 pages; $4.95.

This is a practical man's book, dealing with the techniques of wiring up utilization devices in industrial plants. Chapter One is particularly interesting in that it compares industrial methods of interior electric wiring to other methods. Specific attention is given to the wiring devices characteristic of industrial plants. Succeeding chapters discuss lighting, motors, generators, distribution systems, special circuits, and estimating.

Taken together, this volume represents a good refresher course for the plant electrician, a good text for his apprentices, and a good reference for the engineers responsible for industrial systems.

Turboblowers, by A. J. Stepanoff; John Wiley & Sons, Inc.; 377 pages; $8.00.

This book deals with the hydrodynamic and thermodynamic aspects of turboblower design, particularly as it has developed in the last fifteen years. The book outlines new methods of attack on turbomachine problems. The contribution of European designs is given prominence.

Turboblowers is a good starting point for anyone who wants to undertake a thorough study of the subject. Beginning with selected topics from fluid mechanics, the first few chapters take up definitions and terminology, theory of the centrifugal impeller for incompressible fluids, general characteristics of turbomachinery, and so on. The latter half of the book takes up specific turboblower problems such as casings, leakage, friction, and compression with cooling. The final chapters get into specific equipment such as centrifugal fans, axial flow fans, high pressure multistage compressors, and special problems and applications.

The book is generously illustrated. The graphics have been carefully thought out so that what might have been a dull technical recitation actually is a rather sparkling, easy-to-comprehend work.

Storage Batteries, Fourth Edition, by George Wood Vinal; John Wiley & Sons, Inc.; 446 pages; $10.00.

This book would be a nice supplement to the library of anyone concerned with the operation of storage batteries in an industrial plant. The first four chapters are primarily concerned with batteries as such. They form a rather good basis for the succeeding six chapters, which deal more directly with applying storage batteries.

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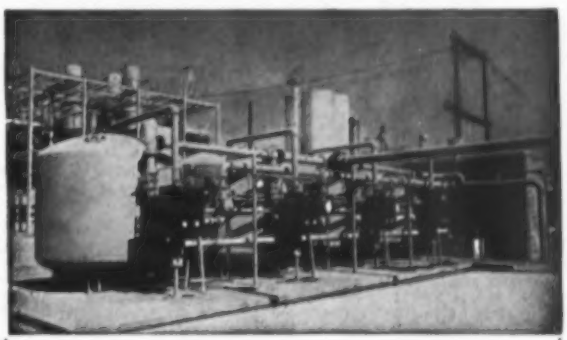

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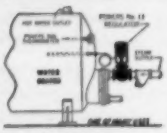

Install Powers No. 11 Self-operated temperature regulators. They prevent OVER-heated water, often pay back their cost 3 to 6 times a year and give years of reliable service. They are simple to install, dependable, economical. Write for Bulletin 329, prices and full information about this quality regulator. (c16)

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bulletins

. . . starts on page 16

POWER TRANSMISSION — MECHANICAL

344—Why Not Eddy-Current Brakes?

Standard eddy-current brakes and associated controls in both air and liquid cooled types are described in 11-page bulletin BR-1. Construction details, capacities, characteristic curves, and dimensions are listed. Dynamatic Div., Eaton Mfg. Co.

346—Diesel Engine Ratings

DR Diesel Engines, as used in municipal power plants, water works, sewage treatment plants, and other industrial applications, are shown in eight-page bulletin S-500-B52B. Rating chart gives information on 5, 6, 7, and 8 cylinder engines from 550 to 2200 hp. Worthington Corp.

347—Poly-V Belt Drive

Design characteristics of the Poly-V drive, a single, endless belt with molded length-wise ribs, are explained in eight-page folder 6638. Line drawings and text compare the Poly-V with conventional drives and point out advantages. Manhattan-Rubber Div., Raybestos-Manhattan.

PUMPS

340—Reduced Speeds Possible

Darcova Pumcups, which permit equipment to be operated at reduced speeds, are described in two bulletins: No. 4502 on Pumcups for air or hydraulic mechanisms; and 4401 on units for reciprocating pumps. Darling Valve & Mfg. Co.

349—Centrifugal Pump Specs

Centrifugal Pumps — Four-page bulletin 512-A gives complete information on the Type SB horizontally split case, double balanced suction pumps including dimensional drawings. Weinman Pump Mfg. Co.

350—Need a Sump Pump?

Automatic sump pumps, standard series, explosion-proof, totally enclosed, and submersible type are described in four-page folder 5382. Penberthy Injector Co., Div. of Buffalo-Eclipse Corp.

352—Sewage and Sump Pumps

Comprehensive, eight-page bulletin 325-A32 is for engineers, architects, and contractors who specify sewage and sump pumps. It describes in detail three types of pumps: The NKS Vertical Wet Pit Single or Duplex; the NKV Vertical Dry Pit; and the NKH Horizontal. American Marsh Pumps, Inc.

353—Opposed Impeller Pump

How opposed impellers balance axial thrust is covered in 12-page brochure 1502. Sizes from 2 to 4 in., with 2 to 8 stages, are presented for capacities to 1000 gpm, pressures to 1200 psig, and temperatures to 350 F. DeLaval Steam Turbine Co.

354—Centrifugal Pumps

Eight-page bulletin 105-B describes Aurora Type O horizontal split case, double suction centrifugal pumps which are recommended for municipal and industrial water supply or for handling circulating and wash water. Aurora Pump Div., New York Air Brake Co.

355—General Purpose Pumps

How to determine total head against which pump must operate is only one of the valuable sections in 12-page bulletin 353-1000 on the Bilton pump, a general purpose pump suitable for medium and low head service. Byron Jackson Co.

REFRACTORIES & INSULATION

356—Castable Refractory Services

Bulletin 35 describes the service whereby this company provides engineering materials and erection service for vessel lining or heat enclosure. Bigelow-Liptak Corp.

359—How to Select Refractory

"Boiler Refractories," 20-page bulletin R-36, has been designed to provide operators of stationary and marine boilers with an authoritative guide for selecting the most efficient and economical refractories for their boilers. Babcock & Wilcox Co., Refractories Div.

STEAM TURBINES

362—Select an Economical Turbine

Full details of this company's steam turbine are given in bulletin 135. How to save operating and maintenance costs by buying the right size for individual needs is explained. Coppus Engineering Corp.

364—How Steam Turbines Work

For a clear picture of how single-stage steam turbines operate, you will want

Bulletin 1954C. Information on availability of various frames for single-stage applications, details on variable speed governors, and other features are included. Eight pages. Worthington Corp.

WASTE DISPOSAL

365—Waste Problems Solved

How this company has solved waste treatment problems for such industries as electro-plating, refinery, gas, and metal finishing is treated in detail in six-page booklet 70-B. Infilco, Inc.

WATER TREATMENT

366—Protection Helps Heat Transfer

"Film Forming Corrosion Inhibitors Also Aid Heat Transfer," four-page technical paper No. 129, contains references to protection afforded by filming amines and attendant reduction in maintenance costs secured through protection against corrosion. W. H. & L. D. Betz.

367—Water Treatments Explained

"Water Conditioning—One Source for Every Need," 19-page bulletin 611B, presents the wide range of products available from this company and explains how each type solves particular problems. Elgin Refinite Div., Elgin Softener Corp.

369—All Phases of Purification

"Boiler Feedwater Treatment," 19-page bulletin BFT-1, covers Inversand zeolite softeners, color process chemical softeners, and demineralizing units, including silica removal by ion-exchange. Hungerford & Terry, Inc.

372—Demineralizing Handbook

"Handbook on Demineralizing," 40-page bulletin 5800-B, compares various methods of water treatment including demineralizers and evaporators. It goes into characteristics of various types of available cation and anion exchange materials and operating costs. Cochrane Corp.

373—Supplementary Water Treatment

"No. 40 Series Supplementary Treatments," three-page booklet 28X8226, discusses supplementary treatments for boiler makeup water such as treatments for softening traces of hardness, dispersives for conditioning of sludge, oxygen scavengers, and anti-foam agents. Allis-Chalmers Manufacturing Co.

374—Spray-atomizing Deaerators

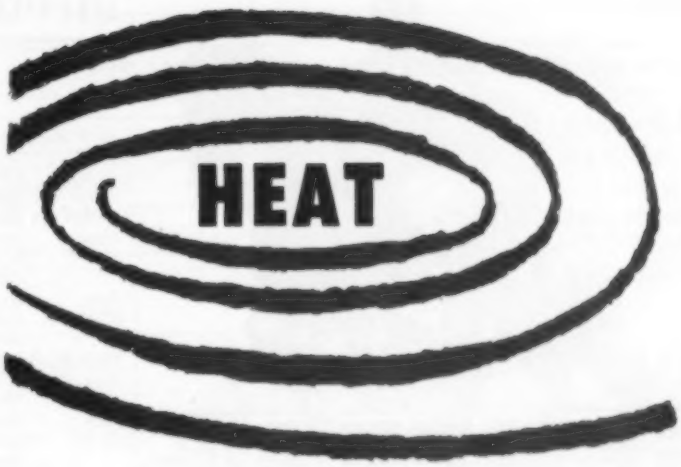
Spray-atomizing type units are shown in cross-section in four-page booklet 400. Function, design and operation, construction, outstanding features, and uses are discussed. American Water Softener Co.

375—How to Use Package Feeders

Proportioning pumps and package chemical feeding units are described in this four-page folder. With liquid ends available for about 85 percent of all chemical pumping requirements, the pump is designed for use where a controlled capacity of fluid is necessary. How the feeding unit can be connected to the piping of your plant and to the electrical control equipment is explained. Bird-Archer Co.

378—Demineralization Principles

"Demineralization including Silica Removal by Ion Exchange," 28-page booklet 3803, describes applications, principles of operation, and gives recommendations for demineralizing and silica removal apparatus and synthetic resins. The Permutit Co.



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June 19-23	American Society of Mechanical Engineers (Semi-Annual Meeting)	Statler Hotel Boston
June 23-25	1955 Heat Transfer and Fluid Mechanics Inst.	U. of Calif. Los Angeles
June 27-29	Am. Soc. of Heating & Air Cond. Engrs. (Semi-Annual Meeting)	San Francisco
June 27-29	American Nuclear Soc. (1st Professional Nuclear Soc. Meeting)	Pa. State College State College, Pa.
June 27-July 1	American Institute of Electrical Engineers (Summer Gen. Meeting)	New Ocean House Swampscott, Mass.
July 12-14	Western Plant Maintenance And Engineering Show	Pan Pacific Auditorium Los Angeles
Aug. 15-19	Am. Institute of Electrical Engineers (Pacific General Meeting)	Butte, Montana
Aug. 22-23	National Industrial Conf. Board & Stanford Research (National Symposium)	San Francisco
Sept. 12-16	American Society of Mechanical Engineers & Instrument Society of Am. (Annual Conf. & Exhibit)	Shrine Exposition Hall Los Angeles
Sept. 12-16	Illuminating Engineering Society National Tech. Conference	Statler Hotel Cleveland

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Ever get confused by the many additives being blended into lubricants? (Additives make up as much as 20 percent of some lubricants.) Next month's Industry & Power will carry a comprehensive story on what additives can do for you. If you have anything to do with industrial lubricants, you will want to read this analysis of what additives can mean to you.

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Annual Review and Forecast, 1955

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The Packaged Boiler Picture

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Adjustable Speed Drives and Electrical Controls

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Boiler Blowdown Control

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Bring Back Those Blowdown Btu's

Coal Burning Equipment Application and Selection

Coal Dust . . . Stopped Before It Starts

Combustion And Combustion Guides

Demineralization . . . A Means of Purer Water

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Engineered Incineration

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Hot Materials Demand Special Conveyor Designs

How To Select Corrugated Expansion Joints

Joining Copper and Its Alloys

LP Means Loss Protection

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New Chemical Grouting Method Prevents Flooded Floors

Profits From Wastes Purchased Vs Generated Power

Put Dissolved Air to Work

Reclaim Your Waste Heat

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Shell Selects Package Boiler for Outdoor Operation

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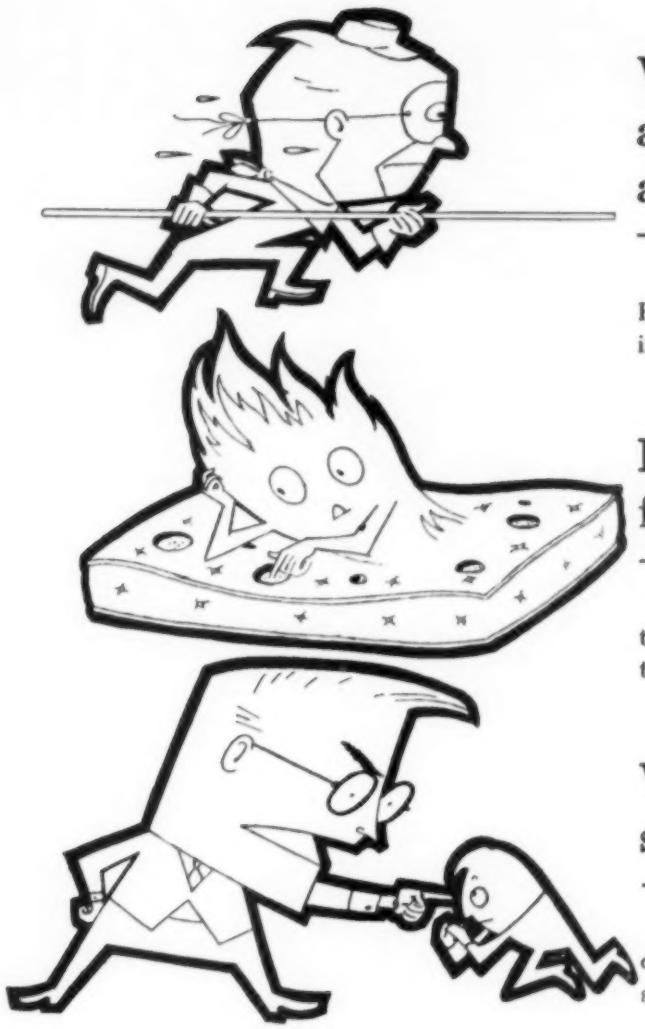

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